

Methodology Note

The Integrated Index for Postal Development:
data sources, formulas, calculations and algorithms

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Introductory note

The Universal Postal Union has undertaken a comprehensive review of the Integrated Index for Postal Development (2IPD) methodology, meticulously incorporating feedback from member countries. This iterative process has resulted in a recalibrated approach which not only enhances the robustness of the index but also ensures its alignment with the diverse realities of all stakeholders.

The periodic reassessment of index methodologies is imperative for multiple reasons. It maintains the relevance and accuracy of the index in dynamic global contexts. Furthermore, it facilitates the integration of emerging data sources and state-of-the-art analytical practices. Importantly, it augments the overall efficacy of the 2IPD as a tool for policy formulation and evaluation. These enhancements collectively contribute to more informed decision-making processes, and yield outcomes of heightened reliability and applicability.

At the UPU, we place paramount importance on the insights provided by our global network of partners and stakeholders. Our commitment to ensuring that each member country's voice is heard and every perspective is duly considered is fundamental to our operational ethos. This inclusive approach not only fortifies the methodological underpinnings of the 2IPD, but also underscores our unwavering dedication to transparency, inclusivity, and excellence in international postal development.

We remain steadfast in our pursuit of continuous improvement, recognizing that active engagement and constructive feedback from our diverse stakeholder base are integral to driving collective progress in the global postal sector.

Calculating Postal Development Levels (PDLs)

A. Overview

The PDLs **represent a country's stage of postal development**. This classification is derived from the statistical distribution analysis of the 2IPD scores of all countries.

Leveraging its extensive big data platform, official postal statistics and surveys, the UPU has devised a classification system featuring 10 postal development levels as outlined below.

The PDL classification breaks down countries into 10 different categories of postal development. These tiers represent statistically identified clusters of development, as determined through an analysis of the respective 2IPD scores.

<i>PDL and economic growth impact</i>		<i>Cohort characteristics from a postal and economic development perspective</i>
	10	PDL 10 represents the pinnacle of postal development, comprising top-performing designated operators (DOs) that are most likely to boost their countries' economic growth and social inclusion. Here, we expect that the impact of postal excellence on the sustainable economic development and eco-systemic value creation is at its peak.
	9	DOs of countries in this group are close to achieving their maximum potential. They positively impact economic development, leveraging their strengths while mitigating the effects of possible remaining weaknesses. Their eco-systemic value could be strengthened.
	8	With an addition step towards reaching excellence, DOs of countries at this level typically provide their citizens with a strong value proposition through their postal services portfolio, decisively contributing to higher economic growth. There is potential to achieve greater eco-systemic value creation.
	7	DOs of countries at this level have probably achieved new milestones in their postal development journey. They play a prominent role in their respective markets and are likely to do so from a general economic development perspective as well. Eco-systemic value creation should be considered.
	6	DOs of countries at PDL 6 are taking steps to accelerate their development. They work intensively on improving performance in critical areas to ensure consistent performance. Their economy will reap the benefits of these investments, achieving higher growth and reducing inequalities.
	5	The core requirements for postal success are in play and a brighter postal future seems possible, in turn enabling positive impacts on the country's economic growth and poverty reduction in the coming years, if the current postal development efforts are maintained.
	4	DOs of countries at PDLs 4 and 3 are approaching, at different speeds, the conditions that are necessary to better serve their current and potential customers, with PDL 3 signaling some postal difficulties. Their contribution to economic development could become larger if sufficient investments are made.
	3	
	2	DOs in this group primarily focus on operations and must significantly improve services and business models in order to be better positioned to seize future opportunities. Only then can they begin to contribute to inclusive economic growth and development in their country.
	1	PDL 1 country DOs are either just starting out or underachieving in terms of postal development. They urgently need to address critical structural issues for their survival, and quickly update their basic postal infrastructure to aid national development.

PDLs are calculated using the 2IPD scoring method, which quantitatively assesses key postal development components like reliability, reach, relevance and resilience. Ensuring data integrity is crucial; inconsistencies are identified and mitigated to ensure accurate scoring.

B. Concepts and notations

The 2IPD methodology employs a multifaceted approach to measurement, considering factors such as infrastructure, service reliability, resilience to shocks, and international postal connectivity. Each of these dimensions is potentially crucial for strengthening a country's economy, creating a more comprehensive and nuanced framework for assessing postal services' contribution to economic growth.

Let's denote the 2IPD score for a country as S_{2IPD} . The PDL can be mathematically expressed as a function of S_{2IPD} , such that $PDL = f(S_{2IPD})$.

The exact relationship or mapping between PDL and S_{2IPD} is determined through clustering analysis, where countries with similar 2IPD scores are grouped to represent specific stages of postal development.

Let G represent the number of groups or classes denoting different postal maturity. The value of G is determined by the abovementioned statistical clustering analysis, such that countries with similar attributes are categorized into distinct G classes of postal development maturity as shown in the table below.

$PDL(G)$	1	2	3	4	5	6	7	8	9	10
S_{2IPD}	$S_{2IPD} < 6$	$6 \leq S_{2IPD} < 16$	$16 \leq S_{2IPD} < 26$	$26 \leq S_{2IPD} < 36$	$36 \leq S_{2IPD} < 46$	$46 \leq S_{2IPD} < 56$	$56 \leq S_{2IPD} < 66$	$66 \leq S_{2IPD} < 80$	$80 \leq S_{2IPD} < 100$	$S_{2IPD} \geq 100$

A 2IPD score of 36 or higher places countries in categories ranging from PDLs 5 to 10, which are indicative of upper-middle to high levels of postal development. As outlined in the previous table, this means that postal services are highly likely to have a positive impact on overall economic growth and resilience.

Conversely, countries with scores below 36 fall into PDLs 1 to 4, indicating low to lower-middle performance. Within these levels, PDLs 3, 2, and 1 signal progressively more significant challenges in postal development.

The Integrated Index for Postal Development

The 2IPD offers a standardized method for assessing postal development in individual countries. The primary objective of the 2IPD methodology is **to help assess the postal development level for each country that consistently contributes the required data to the UPU's statistical, survey and big data systems.**

It provides a valuable metric for research into the postal sector's contribution to overall economic growth. More particularly, this composite index is especially useful for evaluating how postal services have bolstered countries' economic resilience.

Each new data point added to the UPU's systems enhances our collective understanding of global postal development, particularly benefiting less-developed postal services. The information collected serves as an invaluable asset for advancing the sector worldwide.

The index effectively highlights the key drivers of postal development that are crucial for achieving sustainable economic growth.

Furthermore, the 2IPD's multi-faceted approach is vital for adapting to the differing economic realities between countries. For instance, in developed economies, where digital services may be more prevalent, the postal service's role in facilitating e-commerce might be a significant contributor to economic health. On the other hand, in developing nations, the postal network could serve as a crucial channel for basic communication and financial services, affecting economic well-being at a different but equally important level. The PDL framework allows for this level of differentiated understanding, helping policymakers tailor their strategies accordingly.

Finally, the 2IPD methodology's standardized approach provides a common language for international comparison. In a globalized world, understanding how one country's postal services compare to another's can offer valuable insights into competitive advantages or areas for improvement. This global benchmarking is essential for driving data-based policy decisions aimed at optimizing the postal sector's contribution to economic development.

This framework provides nations with a valuable benchmarking tool, allowing policymakers to set targeted goals for postal development. By doing so, they will increase the likelihood of making a positive impact on their own economic growth and population welfare.

However, limited data availability in some cases is a challenge, warranting caution in interpreting associated 2IPD results. **The completeness of data made available to the UPU and accurate measurement is vital for understanding how postal services contribute to economic growth.** It helps identify areas for improvements, informs policy decisions, and allows for international benchmarking, ultimately driving more effective and inclusive economic development.

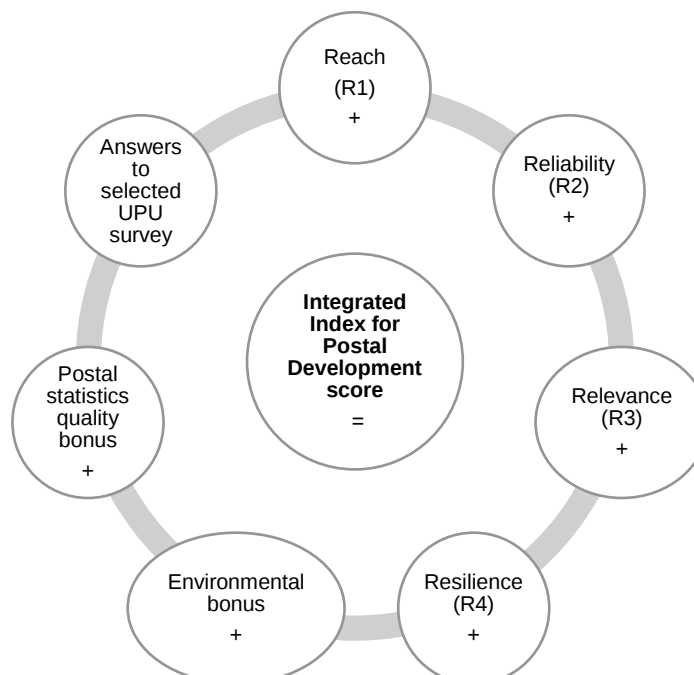
A. The 2IPD scoring system

The Integrated Index for Postal Development is constructed upon four fundamental dimensions of postal sector performance: reach, reliability, relevance, and resilience. These core components remain the primary determinants of the overall score. In addition, the index now incorporates a bonus element which combines two supplementary factors: environmental decoupling efforts and postal statistics quality. This bonus reflects the UPU's commitment to both sustainability and data integrity in postal development.

The scoring mechanism for the four primary dimensions operates on a scale of 0 to 100, with scores determined by relative performance within the assessment year. This approach ensures that the index captures the dynamic nature of postal development across different national contexts.

To account for environmental considerations and data quality, the index awards a combined bonus of up to 14 points. This bonus comprises up to 10 points for demonstrable progress in decarbonization efforts and achievements, serving as an incentive for postal operators to align their operations with global sustainability goals. The three others points are allocated based on the provision of accurate and comprehensive responses to the UPU's official postal statistics questionnaires, underscoring the value of reliable data in fostering evidence-based decision making in the postal sector. Lastly, one point is awarded for participating in a selected UPU survey.

This integrated bonus approach reinforces the UPU's holistic view of postal development, emphasizing both operational sustainability and the importance of high-quality data in shaping the future of postal services globally.



These scores serve as indicators for areas requiring improvement or showcasing success, thereby influencing policy decisions that contribute to sustainable economic growth. Countries are grouped with similar-performing peers and then categorized into one of these 10 development tiers based on their 2IPD scores.

The final 2IPD score for each country is derived through a rigorous multi-step process. Initially, the UPU's extensive big data undergoes comprehensive consistency checks and is processed using a suite of robust algorithms. Subsequently, the four core components – reliability, reach, relevance, and resilience (the four Rs) – are individually computed and normalized. This normalization procedure rescales each component's scores, with the highest-performing country receiving 100 points and the lowest-performing country 0 points, ensuring comparability across dimensions.

In the aggregation phase, the four normalized R components are combined with equal weighting, reflecting their balanced importance in assessing overall postal development. This equiponderated approach yields a composite score that comprehensively captures the multifaceted nature of postal sector performance.

As a final step, the bonus points for environmental decoupling efforts and data quality are added to this composite score. This additive method allows for the recognition of sustainability initiatives and data integrity without distorting the core performance assessment, thus producing the ultimate 2IPD score for each country.

This methodological framework ensures that the 2IPD provides a nuanced, yet standardized measure of postal development across diverse national contexts, while also incentivizing progress in critical areas such as environmental sustainability and statistical reporting.

B. Concepts and notations

2IPD measures the comparative performance of countries in terms of postal development. As a composite index, the individual final scores are based on several components, called sub-variables. These sub-variables are (conceptually) grouped into four pillars: reach, reliability, relevance and resilience.

Sub-scores are computed for each of these pillars and then consolidated into the final score, which takes a value between 0 and 100.

In the description of the 2IPD methodology presented below, a vector notation will be used, with vectors and matrices expressed in bold print. Let a_i be the value of a sub-variable a for the country i . In order to denote a collection of values of a for countries $i=1 \dots k$ the individual values a_i are grouped into a vector: $(a_1, \dots, a_k)^T$.

The rescaling of the vector $\mathbf{a}$ is done by multiplying it by a diagonal matrix $\mathbf{S}$ with typical elements defined as:

$$S[i, i] = 100 \frac{\min_k a - a[i]}{\min_k a - \max_k a}, \quad (1.1)$$

$$S[i, j] = 0 \text{ for } i \neq j$$

Thus, the vector $\mathbf{Sa}$ contains the scores for the sub-variable normalized between 0 and 100.

C. Calculating individual R scores

1 Postal reach (R1)

The reach score is based on the degree of international connectivity of the postal network closely associated with countries' international postal volumes evolution. The connectivity is measured by a combination of multiple factors using several formulas. Firstly, it is linked to international postal volumes, which are measured in one of three ways in terms of **volume unit**: 1) the number of barcoded items in postal dispatches; 2) the weight of those items; or 3) the number of tracked items for each mail segment (letter post, parcel post, and express mail service). Secondly, connectivity is evaluated from two **perspectives**: outbound (the country's export relations) and inbound (the country's import relations). And finally, connectivity is benchmarked using three primary **data sources**. The first is the pre-advice of dispatch (PREDES) EDI messages gathered by the UPU's POST*Net. The second source is the aggregated GXS data from International Postal Corporation (IPC). And the third source consists of item event (EMSEVT) EDI messages, which are collected by the UPU through its

Postal Technology Centre. From this, 10 alternative methods emerge to calculate the reach score (see table 1 below).

Table 1: Reach score calculation methods

Method x	Volume unit	Perspectives	Data source
Method 1	Number of items	Outbound	PREDES
Method 2	Number of items	Outbound	IPC-PREDES ¹
Method 3	Tonnage of items	Outbound	PREDES
Method 4	Tonnage of items	Outbound	IPC-PREDES
Method 5	Tracked items	Outbound	EMSEVT
Method 6	Number of items	Inbound	PREDES
Method 7	Number of items	Inbound	IPC-PREDES
Method 8	Tonnage of items	Inbound	PREDES
Method 9	Tonnage of items	Inbound	IPC-PREDES
Method 10	Tracked items	Inbound	EMSEVT

Notation

K	is the number of countries for which scores are computed
A	is the set of sending/export countries
B	is the set of destinations/import countries
$A \times B$	is the set of all possible country-to-country flows
$O_i D$	is the multiset of all country-to-country registrations for the sending/export country i in the databases. Each country-to-country flow in this multiset belongs to $A \times B$ but some flows may appear many times (it may occur that $ O_i D > A \times B $).
$D_j O$	is the multiset of all country-to-country registrations for the destination/import country j in the databases. Each country-to-country flow in this multiset belongs to $B \times A$ but some flows may appear many times (it may occur that $ D_j O > B \times A $).
n_{ijdc}	is the number of items dispatched from one country to another on date d for mail class c ($c \in \{\text{"letters", "parcels", "express"}\}$).
w_{ijdc}	is the weight in kilogrammes of items dispatched from one country to another on date d for mail class c ($c \in \{\text{"letters", "parcels", "express"}\}$).
t_{ijdc}	is the number of tracked items dispatched from one country to another on date d for mail class c ($c \in \{\text{"letters", "parcels", "express"}\}$).

Sub-variables

Two sub-variables take part in the calculation of the reach score. First, the number of partners is the number of distinct (unique) partnerships between two countries, which is defined as:

$r_{partners_i} = |\text{supp } O_i D|$ from an outbound perspective;

$r_{partners_j} = |\text{supp } D_j O|$ from an inbound perspective.

Second, the total unit volume, in logarithmic scale, dispatched between countries is calculated by first summing the volume of items per mail class and then applying a logarithmic transformation to each class separately before aggregating the results. This approach promotes a more equitable contribution across mail classes in the overall score, while preserving sensitivity to structural differences in volume distribution.

¹ This method adjusts, for IPC members, volumes recorded in the PREDES POST*Net database thanks to additional volume data available in the PREDES IPC GXS dataset.

Outbound perspective:

$$\begin{aligned} \text{rvolume}_i &= \sum_c \ln \left(\sum_d \sum_j n_{ijdc} \right) \\ \text{rvolume}_i &= \sum_c \ln \left(\sum_d \sum_j w_{ijdc} + 1 \right) \\ \text{rvolume}_i &= \sum_c \ln \left(\sum_d \sum_j t_{ijdc} + 1 \right) \end{aligned}$$

Inbound perspective:

$$\begin{aligned} \text{rvolume}_j &= \sum_c \ln \left(\sum_d \sum_i n_{jidc} \right) \\ \text{rvolume}_j &= \sum_c \ln \left(\sum_d \sum_i w_{jidc} + 1 \right) \\ \text{rvolume}_j &= \sum_c \ln \left(\sum_d \sum_i t_{jidc} + 1 \right) \end{aligned}$$

Calculation of the reach score

The last step consists in applying transformation (1.1) to the different combination of sub-variables and data sources described in table 1, and standardizing the average between rpartner and rvolume combination for each method.

$$\text{reach}_x = S(\text{Srpartner} + \text{Srvolume}) \text{ with } x \text{ the method number}$$

Finally, the reach score is defined as the highest value across all methods:

$$\mathbf{Reach} = \mathbf{max}(\mathbf{reach}_x)$$

Hint: This new reach methodology captures more precisely the plurality of connectivity assessments, offering a more accurate analysis for individual countries. This comprehensive revision is crucial for enhancing the accuracy and reliability of the 2IPD scores. Moving forward, the implementation of these refined methodologies will provide a more precise assessment and help address the challenges identified.

2 Postal reliability (R2)

The postal reliability score is determined based on the speed and predictability of delivery within a specific country. This score is calculated using data gathered from tracking events recorded in EMS item events (EMSEVT) EDI messages, collected by the UPU through its Postal Technology Centre. Derived from an extensive analysis of track-and-trace data points related to international postal shipments, this score evaluates the speed and consistency of inbound postal deliveries, serving as a reliable proxy for the quality of domestic delivery service and the customer experience. The underlying assumption for measuring quality of service in this way is that performance should not be assessed according to delivery standards, which are more arbitrary and may vary considerably from one country to another. Instead, the assumption is that high-performing Posts are those that can deliver mail within an acceptable average or median time, with a reasonable amount of variability from this average or median.

Notations

The following notations apply:

T_{cij} is the time elapsed between scanning of the event HI and event D, in country i, for item j belonging to the category of mail c ($c \in \{\text{"letters", "parcels", "express"}\}$)

$\text{av}T_{ci}$ is the average time T_{ci} for mail class c and country i

$\text{av}T_{ci} = \frac{1}{N_{ci}} \sum_{j=1}^{N_{ci}} T_{cij}$, where N_{ci} is the number of valid observations (scanned items) for mail category c in country i

$\text{sd}T_{ci}$ is the standard deviation of observations T_{cij} from mean $\text{av}T_{ci}$

$$sdT_{ci} = \sqrt{\frac{\sum_{j=1}^{N_{ci}} (T_{cij} - avT_{ci})^2}{N_{ci} - 1}}$$

$medT_{ci}$ is the median time T_{ci} for mail class c and country i

$medT_{ci} = T_{c, (\frac{n+1}{2})}$, if the total number of values is odd

$medT_{ci} = \frac{T_{c, \frac{n}{2}} + T_{c, (\frac{n}{2}+1)}}{2}$, if the total number of values is even

$iqrT_{ci}$ is the interquartile range of observations T_{cij}

$$iqrT_{ci} = Q_{0.75} - Q_{0.25}$$

$Q_{0.25} = X_{(\frac{n+1}{4})}$ and $Q_{0.75} = X_{(3 \times \frac{n+1}{4})}$, if the total number of values is odd

$Q_{0.25} = \frac{X_{(\frac{n}{4})} + X_{(\frac{n}{4}+1)}}{2}$ and $Q_{0.75} = \frac{X_{(3 \times \frac{n}{4})} + X_{(3 \times \frac{n}{4}+1)}}{2}$ if the total number of values is even

Sub-variables

There are two main sub-variables. First, the speed of delivery, is defined in two ways:

$$rspeed_1_i = \frac{1}{N_i} \sum_{c=1}^{N_i} avT_{ci}$$

$$rspeed_2_i = \frac{1}{N_i} \sum_{c=1}^{N_i} medT_{ci}$$

The speed of delivery, $rspeed_i$, is the average across mail classes of avT_{ci} or $medT_{ci}$ for country i , and N_i represents the number of different mail classes (letters, parcels, express) in country i .

Second, the predictability of delivery, $rpredi_i$, can be defined as:

$$rpredi_1_i = \frac{1}{N_i} \sum_{c=1}^{N_i} sdT_{ci}$$

$$rpredi_2_i = \frac{1}{N_i} \sum_{c=1}^{N_i} iqrT_{ci}$$

where $rpredi_i$ is the simple average of sdT_{ci} or $iqrT_{ci}$ over valid mail classes for country i , and N_i is the number of valid avT_{ci} or $medT_{ci}$ times for country i .

Calculation of the reliability score

The next step for the reliability pillar consists in applying transformation (1.1) to the sub-variables and standardizing the average between the different combination between 0 and 100:

$$\begin{aligned} Srspeed &= S(-rspeed) \\ Sprpredi &= S(-rpredi) \end{aligned}$$

Hint: The lower the value of $rspeed_i$ and $rpredi_i$, the better the performance is.

A series of transformations was applied to compute the final reliability score, resulting in the emergence of three distinct methods. A key distinction — beyond the definitions of *rspeed* and *rpredi* — lies in the thresholds used to determine the reliability score. For the first and second methods, a threshold of 1.5 is applied, while for the third method, the threshold is set at 2.5.

$$\begin{aligned} reliability_1 &= S(Srspeed_1_i + Sprpredi_1_i) \text{ with a 1.5 threshold} \\ reliability_2 &= S(Srspeed_2_i + Sprpredi_2_i) \text{ with a 1.5 threshold} \end{aligned}$$

$$\text{reliability}_3 = S(\text{Srspeed}_{1i} + \text{Srpredi}_{1i}) \text{ with a 2.5 threshold}$$

This condition was introduced to correct a specific bias: some countries demonstrate strong internal logistics but perform poorly in external logistics. To address this, a corrective mechanism was implemented. If the reliability score exceeds the reach score by more than 1.5 times (or 2.5 times for the third method), the reach score is used instead.

The final reliability score is the highest value between reliability_1 , reliability_2 , and reliability_3 :

$$\text{Reliability} = \max(\text{reliability}_1; \text{reliability}_2; \text{reliability}_3)$$

Hint: The reliability score calculation employs three methods to account for varying data distributions across countries. The first and third methods, reliability_1 and reliability_3 , utilize the mean for rspeed and standard deviation for rpredi , while the second method, reliability_2 , uses the median for rspeed and interquartile range (IQR) for rpredi . This dual approach offers flexibility in data interpretation for each country. When considering rspeed (delivery speed), there may be instances where the median is notably lower than the mean, such as a median of two days compared to a mean of five days. This scenario suggests that most deliveries are completed quickly, with a few outliers causing the higher mean. In such cases, the median (used in reliability_2) more accurately represents typical performance. Similarly, for rpredi (delivery predictability), a high standard deviation might result from extreme values. The IQR (used in reliability_2) can provide a more robust measure of variability by excluding these outliers. By selecting the maximum value between reliability_1 , reliability_2 , and reliability_3 each country benefits from the method that best represents its performance, effectively mitigating the impact of extreme values or unique conditions, such as geographical difficulties, that could skew the results. This approach ensures a fairer assessment of postal reliability for each country, striking a balance between consistency in typical performance and the flexibility to account for different data distributions related to countries' geographical features.

3 Postal relevance (R3)

The relevance score measures the degree of competitiveness of a given operator in its most important business segment (letters, parcels, financial services, other services), as well as the density of its infrastructure. To this end, the most important business segment is first identified, then compared with the best performing operator for this segment in the world.

This component amalgamates customer demand data across various postal services – from domestic to international deliveries, financial services and other services – as well as the density of post offices, lockers and mobile offices in a country. It identifies strong and weak points in a country's postal business model, assigning scores accordingly. Strong demand for postal services, including counter services, can facilitate economic transactions in a very wide range of sectors and industries, as typically reflected by relevance scores above 20.

The (rescaled) distance from the best performing operator becomes the first sub-variable. The second sub-variable is the rescaled number of access points. Contrary to what was done for the previous pillars, the sub-scores of relevance do not receive the same weight in the final calculation.

The data needed to compute the relevance score is derived from the official UPU Postal Statistics, the pre-advice of dispatch (PREDES) EDI messages gathered by the UPU, and the data from IPC.

Notations

k	is the number of countries for which scores are computed for the given year.
vpal_i	is the percentage of revenue generated by the letter post for the given country i. If not available for the given year, the latest value from the last two years is taken.
vcol_i	is the percentage of revenue generated by parcel post and logistics. If not available for the given year, the latest value from the last two years is taken.
vsfp_i	is the percentage of revenue generated by financial postal services. If not available for the given year, the latest value from the last two years is taken.
vaut_i	is the percentage of revenue generated by other services. If not available for the given year, the latest value from the last two years is taken.

- $palint_i$ is the number of domestic letter-post items in country i .
 $palexp_i$ is the number of international exported letter-post items in country i .
 $cpinte_i$ is the number of domestic parcel-post items in country i .
 $cpexpe_i$ is the number of international exported parcel-post items in country i .
 $expint_i$ is the number of domestic express-post items in country i .
 $expexp_i$ is the number of international exported express-post items in country i .
 $popul_i$ is the population of country i .
 $bseden_i$ is the value of permanent post offices (including outsourced ones) in country i .
 $aplock_i$ is the number of automated parcel lockers.
 $burmob_i$ is the number of mobile post offices (including rural delivery staff).
 $pertot_i$ is the total number of postal staff in country i .

Sub-variables

The improved methodology of relevance integrates several developments explained in table 2 below. Before the explanation, and identification of the most important segment, it is necessary to define a certain number of variables.

Top-performing infrastructure

infra_i:

$$infra_1_i = \frac{bseden_i}{popul_i}; \quad infra_2_i = \frac{bseden_i + aplock_i}{popul_i}; \quad infra_3_i = \frac{bseden_i + burmob_i}{popul_i}; \quad infra_4_i = \frac{bseden_i + aplock_i + burmob_i}{popul_i}$$

- $infra_1_i$ is the number of permanent post offices per capita in country i .
 $infra_2_i$ is the number of permanent post offices and automated parcel lockers per capita in country i .
 $infra_3_i$ is the number of permanent and mobile (including rural delivery staff) post offices per capita in country i .
 $infra_4_i$ is the number of permanent and mobile (including rural delivery staff) post offices and automated parcels lockers per capita in country i .

Hint: The idea behind these first improvement series is to take into consideration all postal access, and to show the intensity of different access points as well as the coverage in rural areas. That is why, in addition to the value of permanent offices in country i , the following indicators are added: number of automated parcel lockers; and number of mobile post offices (including rural delivery staff) for country i . To offer a degree of flexibility, the future scores will be calculated with each type of infrastructure – $infra_1$, $infra_2$, $infra_3$, and $infra_4$.

Top-performing segments

tcol_i:

$$tcol1_i = \frac{vcol_i}{vpal_i} tpal1_i; \quad tcol2_i = \frac{cpinte_i + cpexpe_i}{popul_i}; \quad tcol3_i = \frac{cpinte_i + cpexpe_i}{pertot_i}$$

$$tcol4_i = \frac{cpinte_i + cpexpe_i + expint_i + expexp_i}{popul_i}; \quad tcol5_i = \frac{cpinte_i + cpexpe_i + expint_i + expexp_i}{pertot_i}$$

- $tcol1_i$ is the number of postal transactions attributed to parcel post, but expressed in “letter-post units”.
 $tcol2_i$ is the number of parcel-post transactions per capita in country i .
 $tcol3_i$ is the number of parcel-post transactions per employee in country i .
 $tcol4_i$ is the number of parcel- and express-post transactions per capita in country i .
 $tcol5_i$ is the number of parcel- and express-post transactions per employee in country i .

tpal_i:

$$\text{tpal1}_i = \frac{\text{palint}_i + \text{palexp}_i}{\text{popul}_i}; \text{tpal2}_i = \frac{\text{vpal}_i}{\text{vcol}_i} \text{tcol2}_i; \text{tpal3}_i = \frac{\text{vpal}_i}{\text{vcol}_i} \text{tcol4}_i; \text{tpal4}_i = \frac{\text{vpal}_i}{\text{vcol}_i} \text{tcol3}_i; \text{tpal5}_i = \frac{\text{vpal}_i}{\text{vcol}_i} \text{tcol5}_i$$

tpal1_i is the number of letter-post transactions per capita in country i.

tpal2_i is the number of postal transactions attributed to letter post, but expressed in “parcel-post units”.

tpal3_i is the number of letter-post transactions, but expressed in “parcel- and express-post units”.

tpal4_i is the number of letter-post transactions, but expressed in “parcel-post units per employee”.

tpal5_i is the number of letter-post transactions, but expressed in “parcel- and express-post units per employee”.

tsfp_i:

$$\text{tsfp1}_i = \frac{\text{vsfp}_i}{\text{vpal}_i} \text{tpal1}_i; \text{tsfp2}_i = \frac{\text{vsfp}_i}{\text{vcol}_i} \text{tcol2}_i; \text{tsfp3}_i = \frac{\text{vsfp}_i}{\text{vcol}_i} \text{tcol4}_i; \text{tsfp4}_i = \frac{\text{vsfp}_i}{\text{vcol}_i} \text{tcol3}_i; \text{tsfp5}_i = \frac{\text{vsfp}_i}{\text{vcol}_i} \text{tcol5}_i$$

tsfp1_i is the number of postal transactions attributed to postal financial services, but expressed in “letter-post units”.

tsfp2_i is the number of financial services post transactions, but expressed in “parcel-post units”.

tsfp3_i is the number of financial services post transactions, but expressed in “parcel- and express-post units”.

tsfp4_i is the number of financial services post transactions, but expressed in “parcel-post units per employee”.

tsfp5_i is the number of financial services post transactions, but expressed in “parcel- and express-post units per employee”.

taut_i:

$$\text{taut1}_i = \frac{\text{vaut}_i}{\text{vcol}_i} \text{tcol2}_i; \quad \text{taut2}_i = \frac{\text{vaut}_i}{\text{vcol}_i} \text{tcol4}_i$$

taut1_i is the number of other product transactions, but expressed in “parcel-post units”.

taut2_i is the number of other product transactions, but expressed in “parcel and express-post units”.

Hint: The original method for identifying the most important segment relies on assumptions that are no longer up to date for many countries; this is why additional sub-variables are taken into consideration. A first improvement is that, instead of expressing the sub-variables in “letter-post units”, they are expressed in “parcel-post units” and in “parcel- and express-post units”. The rationale is that letter-post traffic is no longer the dominant mail class in the market. Parcel-post and express traffic are currently very important and non-negligible for countries. The second improvement involves taking into account “other product transactions” as a business segment. This addition enables a more comprehensive segment approach by country. Finally, instead of expressing postal transactions per capita, a productivity vision “per employee” is adopted, which can be interpreted as the number of postal transactions processed per employee. All these sub-variables are distributed among seven methods, allowing a more insightful approach to different business segment models (see table 2).

Table 2: Relevance score calculation methods

	Method 1	Method 2a	Method 2b	Method 3a	Method 3b	Method 4a	Method 4b
Explanation	Original in letter-post units	Parcel-post units per capita	Parcel- + express-post units per capita	Parcel-post units + other services inclusion per capita	Parcel- + express-post units + other services inclusion per capita	Parcel-post units per employee	Parcel- + express-post units per employee
$tpal_i$	$tpal1_i$	$tpal2_i$	$tpal3_i$	$tpal2_i$	$tpal3_i$	$tpal4_i$	$tpal5_i$
$tcol_i$	$tcol1_i$	$tcol2_i$	$tcol4_i$	$tcol2_i$	$tcol4_i$	$tcol3_i$	$tcol5_i$
$tsfp_i$	$tsfp1_i$	$tsfp2_i$	$tsfp3_i$	$tsfp2_i$	$tsfp3_i$	$tsfp4_i$	$tsfp5_i$
$taut_i$	/	/	/	$taut1_i$	$taut2_i$	/	/

Identification of top-performing segments and infrastructures by method

The observations $tpal_i$, $tcol_i$, $tsfp_i$, $taut_i$, $infra_i$ are stacked up for all countries into vectors **tcol**, **tcol**, **tsfp**, **taut**, **infra**, which in turn are rescaled according to (1.1).

This yields five vectors: **Stpal**, **Stcol**, **Stsfp**, **Staut**, **Sinfra**.

For each method, the top-performing segment is identified for each country:

$Strans_i = \max\{Stpal_i, Stcol_i, Stsfp_i\}$ for method 1, 2a, 2b, 4a and 4b

$Strans_i = \max\{Stpal_i, Stcol_i, Stsfp_i, Staut_i\}$ for method 3a and 3b

Calculation of relevance scores by method

The relevance scores are the following linear combination of **Strans** and **Sinfra** with a different weighting system:

$$Relevance1_i = S(0.75 \times Strans_i + 0.25 \times Sinfra1_i)$$

$$Relevance2_i = S(0.75 \times Strans_i + 0.25 \times Sinfra2_i)$$

$$Relevance3_i = S(0.75 \times Strans_i + 0.25 \times Sinfra3_i)$$

$$Relevance4_i = S(0.75 \times Strans_i + 0.25 \times Sinfra4_i)$$

&

$$Relevance5_i = S(0.67 \times Strans_i + 0.33 \times Sinfra1_i)$$

$$Relevance6_i = S(0.67 \times Strans_i + 0.33 \times Sinfra2_i)$$

$$Relevance7_i = S(0.67 \times Strans_i + 0.33 \times Sinfra3_i)$$

$$Relevance8_i = S(0.67 \times Strans_i + 0.33 \times Sinfra4_i)$$

$$Relevance_i = \max\{Relevance1_i, Relevance2_i, Relevance3_i, Relevance4_i, Relevance5_i, Relevance6_i, Relevance7_i, Relevance8_i\}$$

Hint: The change in weighting provides greater sensitivity in assessing the best-performing segment and its infrastructure. This offers greater adaptability of the relevance score by country.

Final calculation of the relevance score

The final step for the relevance score consists of selecting the highest score among all the methods for each country:

$$\text{Relevance} = \max\{\text{Relevance}_1, \text{Relevance}_{2a}, \text{Relevance}_{2b}, \text{Relevance}_{3a}, \text{Relevance}_{3b}, \text{Relevance}_{4a}, \text{Relevance}_{4b}\}$$

4 Postal resilience (R4)

The resilience score relies on a number of factors which determine a postal operator's adaptability to economic, social, technological and environmental shocks.

This facet evaluates the postal system's ability to adapt to economic and technological disruptions, while also highlighting its role in advancing a country's social inclusion initiatives.

Firstly, a new dimension of the resilience score is integrated: postal network logistical effectiveness. This will enable us to assess, thanks to item tracking, the postal network and its efficacy in each country. Secondly, a combination of factors such as business resilience, mail volume decline rate, level of economies of scale achieved by the postal mail delivery network, or the degree of diversification in terms of postal revenues measures the level of economic strength of a given postal business model in response to both macroeconomic and technological shocks.

Moreover, the potential for delivering financial inclusion through the postal network constitutes a measure of the level of social resilience provided by postal operators in order to mitigate economic and social inequalities within any given country.

The data needed to compute the resilience score is sourced from the UPU Postal Statistics and the tracking events recorded in EMS item event (EMSEVT) EDI messages. Regarding financial inclusion, a principal component analysis was run to provide a score thanks to data from the UPU's Global Panorama on Financial Inclusion.

Notations

Let us denote by:

k	the number of countries for which scores are computed for the given year.
$vpal_i$	the proportion of revenue generated by letter post for the given country i .
$vcol_i$	the proportion of revenue by parcel post and logistics.
$vsfp_i$	the percentage of revenue generated by financial postal services.
$vaut_i$	the percentage of revenue generated by other services.
$palint_i$	the number of domestic letter-post items in country i for the given year.
$palexp_i$	the number of international exported letter-post items in country i for the given year.
$expint_i$	the number of domestic express-post items in country i .
$cpinte_i$	the number of domestic parcel-post items in country i .
$palint_prev_i$	the number of domestic letter-post items in country i three years ago.
$palexp_prev_i$	the number of international exported letter-post items in country i three years ago.

Notations EMSEVT events

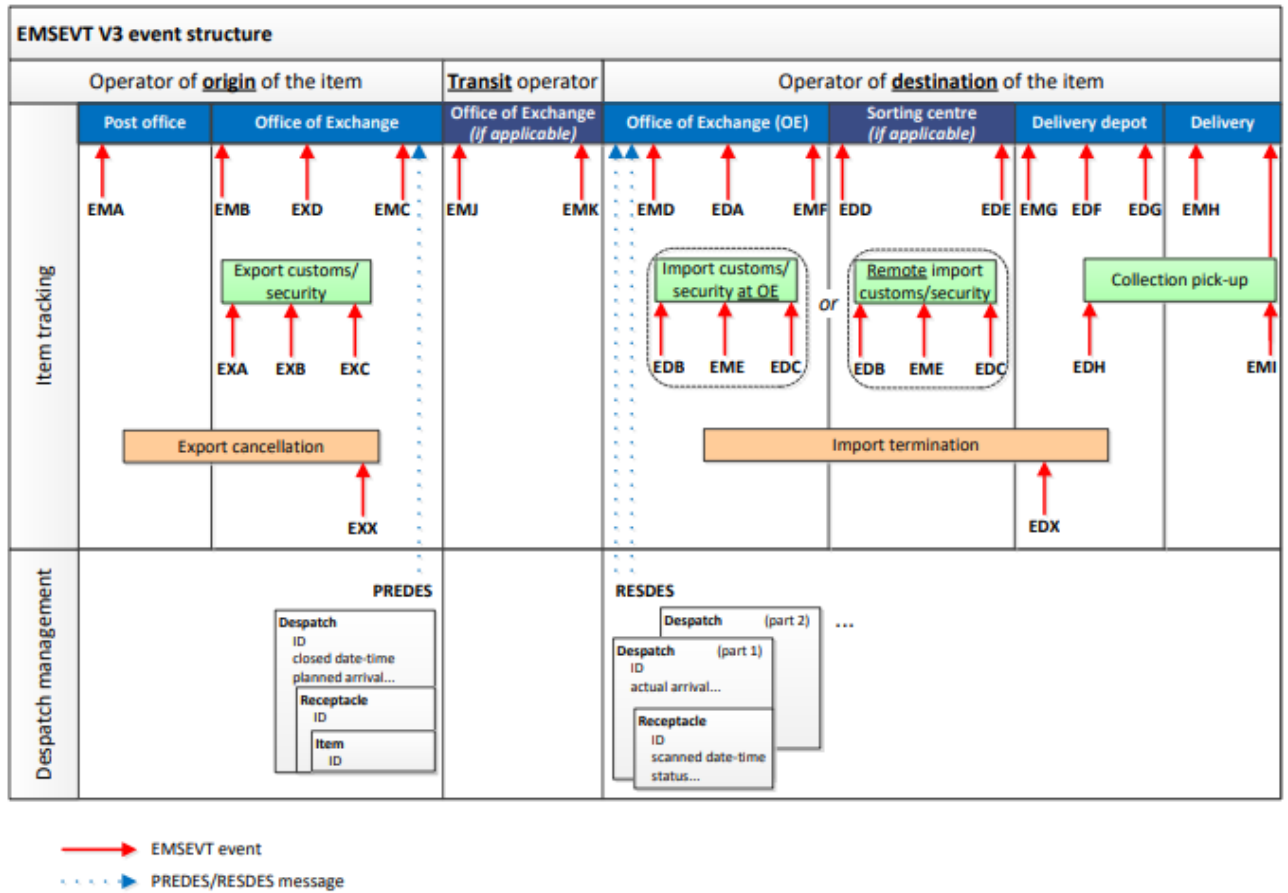
EMA	the posting/collection event.
EMB	the arrival at outward office of exchange event.
EXA	the item presented to export customs/security event.
EXB	the item held by export customs/security event.
EXC	the item returned from export customs/security event.
EXD	the item held at outward office of exchange event.

EXX	the export cancellation event.
EMC	the departure from outward office of exchange event.
EMJ	the arrival at transit office of exchange event.
EMK	the departure from transit office of exchange event.
EMD	the arrival at inward office of exchange event.
EDA	the held at inward office of exchange event.
EDB	the item presented to import customs event.
EME	the item held by import customs event.
EDC	the item returned from import customs event.
EMF	the departure from inward office of exchange event.
EDD	the item into sorting center event.
EDE	the item out of sorting center event.
EMG	the arrival at delivery office event.
EDF	the item held at delivery depot event.
EDG	the item out for physical delivery event.
EDH	the item arrival at collection point for pick-up (by recipient) event.
EDX	the import terminated event.
EMH	the attempted/unsuccessful (physical) delivery event.
EMI	the final delivery event.

In the figure below, the events structure is illustrated. There are three main distinct operators in the process:

- *Operator of origin of the item* composed of eight events dispatched between the post office and the office of exchange;
- *Transit operator* composed of two events at the office of exchange; and
- *Operator of destination of the item*, consisting of 15 events distributed between the office of exchange, the sorting centre, the delivery depot and the final delivery.

Figure 1: EMSEVT V3 event structure



a Postal network logistic effectiveness

Sub-variables

Tracking evaluation

The first indicator of this dimension is the postal tracking score at the origin and destination, i.e. how a sender country postal system works and how, for this same country, the receipt of items will be handled. This tracking score tells us how developed a country's network is, and also reflects the investment in its own postal network, indicating the efficiency and potential issues in this stage of the delivery process.

tracking_origin_i is the tracking score in the sender country.

$$\text{tracking_origin}_i = \left| \frac{\text{EMC}}{\text{EMA}} - 1 \right|$$

tracking_destination_i is the tracking score in the recipient country.

$$\text{tracking_destination}_i = \left| \frac{\text{EMI}}{\text{EMD}} - 1 \right|$$

Hint: The smaller the difference, the better it is.

To evaluate how a country handles the sending and receiving part of its postal traffic, the transformation (1.1) is applied:

$$\text{tracking}_i = S(\text{tracking_origin}_i + \text{tracking_destination}_i)$$

Final delivery

The second indicator assesses the extent to which shipments need to be re-delivered. It can be interpreted as a measure of the efficiency and effectiveness of the physical delivery process from a logistical point of view. The fewer failures there are, the more efficient the postal network is. For this, we calculate the score of the two ratios below and select the maximum value between them.

$$\text{delivery_fail_inward}_i = \frac{\text{EMH}}{\text{EMD}}$$

Hint: This ratio gives an indication of the proportion of deliveries that face issues after arriving at the inward office of exchange and before they are successfully delivered. A lower ratio suggests that a smaller proportion of deliveries encounter problems after arriving at the inward office, indicating a more efficient delivery process.

$$\text{delivery_fail_final}_i = \frac{\text{EMH}}{\text{EMI}}$$

Hint: This gives an indication of the proportion of unsuccessful delivery attempts relative to successful deliveries. Here, a lower ratio suggests a higher effectiveness in the delivery process, indicating that a smaller proportion of deliveries encounter problems and most deliveries are successfully completed.

Finally, we applied the transformation (1.1):

$$\text{delivery}_i = \max [\text{Sdelivery_fail_inward}_i, \text{Sdelivery_fail_final}_i]$$

Density of tracking

For this last indicator, the density of international logistics flows is assessed. As before, this indicator evaluates the capacity put in the postal network and the efficiency of the process at the export and import steps.

export_tot_i captures total export activities, taking into account events linked to the collection, processing and departure of items from the external office of exchange.

$$\text{export_tot}_i = \log (\text{EMA} + \text{EMB} + \text{EXA} + \text{EXB} + \text{EXD} + \text{EXC} + \text{EXX} + \text{EMC})$$

import_tot_i represents the total volume of import activities, encompassing events related to the receipt, processing and delivery of items within the internal office of exchange network.

$$\text{import_tot}_i = \log (\text{EMD} + \text{EDA} + \text{EDB} + \text{EME} + \text{EDC} + \text{EMF} + \text{EDD} + \text{EDE} + \text{EMG} + \text{EDF} + \text{EDG} + \text{EDH} + \text{EMH} + \text{EMI})$$

The last step consists in applying transformation (1.1) to the two sub-variables:

$$\text{density}_i = \max [\text{Sexport_tot}_i, \text{Simport_tot}_i]$$

Hint: The maximum choice between Sexport_tot and Simport_tot provides a certain flexibility by country. In some cases, imports represent a larger share than exports, allowing for resource adjustments to be made accordingly. The goal of this approach is to avoid penalizing countries based on the relative size of their economic sectors.

Postal network logistical effectiveness score

The final phase for this first new dimension is to combine our three indicators:

$$\text{logistic_tot}_i = S\left(\frac{1}{3}\text{tracking}_i + \frac{1}{3}\text{delivery}_i + \frac{1}{3}\text{density}_i\right)$$

b Economic and technological disruptions, and social inclusion

Sub-variables

Business resilience

First of all, we assess how the decline in letter-post volume is compensated for by the increasing parcels and express volumes, and we applied the transformation (1.1):

$$\text{business}_i = S\left(\frac{\text{PALINT}_i}{\text{CPINTE}_i + \text{EXPINT}_i}\right)$$

Hint: If the ratio is low, this means that the letter-post volume is offset by the parcels and express volume. For example, if the ratio equals 0.5, there is one letter for every two parcels/ express items, meaning that the country is suffering less of a decline than a country where the ratio is 2, i.e. two letters for every parcel/express items; in that situation, letter post is the principal source of business revenue, but the decline observed globally may not be well compensated for.

Economic resilience

$vdec_i$ is the ratio of decline of letter-post volumes.

$$vdec_i = \frac{\text{palint}_i + \text{palexp}_i}{\text{palint_prev}_i + \text{palexp_prev}_i}$$

$veco_i$ is the number of letter-post items per capita.

$$veco_i = \frac{\text{palint}_i + \text{palexp}_i}{\text{popul}_i}$$

$sdec_i$ is the indicator of letter-post decline in country i .

$$sdec_i = \frac{1}{1 + e^{-10(vdec_i - 0.9)}}$$

Hint: This function takes a value between 0 and 1. If the ratio of decline of letter post is below the threshold of 0.9, the function rapidly tends towards 0. Conversely, above the threshold it rapidly tends towards 1.

$seco_i$ is the indicator of economies of scale for country i (threshold = 15).

$$seco_i = \frac{1}{1 + e^{-(veco_i - 15)}}$$

$seor_i$ is the indicator of concentration on services other than postal business.

$$seor_i = \frac{1}{1 + e^{(vaut_i - 33.3)}}$$

Hint: Above the threshold of 33.3% the function tends rapidly towards 0; below the threshold towards 1.

$scon_i$ is the indicator of diversification of services in country i .

$$scon_i = \sqrt{(1 - vpal_i)(1 - vcol_i)(1 - vsfp_i)}$$

Hint: The variables $vpal_i$, $vcol_i$, $vsfp_i$ are the relevant proportions of revenue generated by the given service, and here they are represented by values between 0 and 1 and not, as in Postal Statistics, in percentages. The higher the diversification, the greater the function value. If the arguments are missing, the function will get the value of 0.

$fincl_i$ is the individual score of country i in Postal Financial Potential Success Index as found in the UPU's Global Panorama for Financial Inclusion.

The variable of economic resilience:

$$ecores_i = sdec_i + seco_i + scon_i + seor_i$$

Intermediate score:

$$\text{resilience_int}_i = \max[\text{Secores}_i, \text{Sbusiness}_i]$$

Financial inclusion score:

$$\text{fin_incl}_i = S(\text{fincl}_i)$$

Intermediate score:

$$\text{resilience_int_2}_i = S(\text{resilience_int}_i + \text{fin_incl}_i)$$

Economic and business resilience score:

$$\text{eco_buss}_i = \max[\text{resilience_int}_i, \text{resilience_int_2}_i]$$

c Calculation of the resilience score

Finally, the resilience score is defined as follows:

$$\text{Resilience} = S(\text{logistic_tot} + \text{eco_buss})$$

Hint: This new resilience score embraces a more global resilience of countries' postal system. It relies not only on economic resilience but also on postal network logistics, and tracking strengthens the resilience of postal operators by improving visibility, responsiveness, resource management and communication.

5 Composite 2IPD score

Once all the scores for the four pillars have been computed, the final 2IPD scores can be obtained. For each country, the sum of the four scores is taken and then rescaled according to (1.1).

$$S_{2IPD} = S\left(\frac{1}{4}\text{Reach} + \frac{1}{4}\text{Reliability} + \frac{1}{4}\text{Relevance} + \frac{1}{4}\text{Resilience}\right)$$

In addition, this year, three types of bonus points are added to the 2IPD scores. First, there are between 0 and 3 points, based on an algorithm, accorded for the quality of the data supplied by countries. Then, between 0 and 10 points are awarded to countries that progress towards decoupling their postal sector, i.e., "breaking the link between environmental bads and economic goods."² Between 0 and 2 points are attributed at the beginning of the decoupling effort, between 2 and 4 points for an even greater effort, 4 to 7 points when significant progress has been achieved, and 7 to 10 points for countries with strong decoupling between emissions and postal traffic. Lastly, one point is awarded for participating in a selected UPU survey.

² OECD (2008). Measuring material flows and resource productivity: The OECD Guide.