Composite Indicators – A review

Second Workshop on Composite Indicators of Country Performance,
Feb. 26-27th 2004
OECD, Paris

Michaela Saisana
Group of Applied Statistics
Joint Research Centre
European Commission

http://www.jrc.cec.eu.int/uasa
A first look

GDP

Internal Market Index

Business climate indicator

Environmental Sustainability Index

http://www.jrc.cec.eu.int/uasa
Definition

Technical:
Composite indicators are mathematical combinations (or aggregations) of a set of indicators.

Conceptual:
“Composite indicators are based on sub-indicators that have no common meaningful unit of measurement and there is no obvious way of weighting these sub-indicators”
(Source: Note on composite indicators, EC, Brussels, March 2002)
Pros of Composite Indicators

- To summarise complex or multi-dimensional issues.
- To place countries’ performance at the centre of the policy arena.
- To offer a rounded assessment of countries’ performance.
- To enable judgments to be made on countries’ efficiency.
- To facilitate communication with ordinary citizens.
- To be used for benchmarking countries of best performance.
- To indicate which countries represent the priority for improvement efforts.
- To stimulate the search for better data and better analytical efforts.
- To set local priorities, and to seek out improvements along dimension of performance where gains are most readily secured.
Cons of Composite Indicators

• May send misleading, non-robust policy messages.
  → Sensitivity analysis for robustness assessment

• May invite stakeholders to draw simplistic conclusions.
  → Consideration of subindicators

• Involve judgmental decisions
  → Transparency in judgement

• Increase the quantity of data needed.

• May disguise serious failings in some parts of some systems.
  → Consideration of subindicators

• May rely on very feeble data in some dimensions.

• May ignore dimensions of performance that are not measurable.
Debate on Composite Indicators ever settled?

Pros

- To summarise complex or multi-dimensional issues and provide the big picture.
- To place system performance at the centre of the policy arena.
- To offer a rounded assessment of system performance.
- To enable judgments to be made on system efficiency.
- To facilitate communication with ordinary citizens and promote accountability.
- To indicate which systems represent the beacon of best performance.
- To stimulate the search for better data and better analytical efficiency.
- To offer local policy makers the freedom to set their own priorities and to focus on dimensions of performance where gains are most readily secured.

Cons

- May send misleading non-robust policy messages if they are poorly constructed or misinterpreted.
- May invite politicians to draw simplistic policy conclusions.
- May involve judgmental decisions (e.g. sub-indicators, weights) that could be the target of political challenge.
- May disguise serious failings in some parts of some systems.
- May have to rely on very feeble or opaque data or even contentious in some dimension of performance.
- May ignore dimensions of performance that are difficult to measure may distort behavior in undesirable ways.
- May invite statisticians to view data collection and editing as “wasted” or “hidden” behind a single number of dubious significance.

Hard to imagine that debate on the use of composite indicators will ever be settled.

Stakeholders tempted to summarise complex (elusive) processes into a single figure to benchmark country performance for policy consumption.
Debate on Composite Indicators ever settled?

All things considered, composite indicators should be identified for what they are:

simplistic presentations and comparisons of performance in given areas to be used as starting points for further analysis and discussion
Thematic categories of Composite Indicators

- Environment
- Society
- Economy
- Innovation/Technology/Information
- Globalisation
Examples of composite indicators

Environment

• Environmental Sustainability Index (WEF)
• Air Quality Index (WEF)
• Environment Index (World Travel and Tourism Council)
• Environmental Performance Index (WEF, Yale & Columbia Universities)
• Living Planet Index (UNEP & WCMC)
• National Biodiversity Index (Secretariat of the Convention on Biological Diversity)
• Natural Capital Index (RIVM, The Netherlands)

A more complete list available on web:
http://farmweb.jrc.cec.eu.int/ci/
Examples of composite indicators

Society

• Human Development Index (United Nations)
• Health System Achievement Index (WHO)
• Corruption Perceptions Index (Transparency International)
• World Income Inequality Database: Gini Index (United Nations)
• Wellbeing Index (Prescott-Allen)
• Genuine Progress Indicator (Redefining Progress)

A more complete list available on web:
http://farmweb.jrc.cec.eu.int/ci/
Examples of composite indicators

**Economy**

- Economic Sentiment Indicator (EC)
- Composite Leading Indicators (OECD)
- Internal Market Index (EC)
- Doing Business Indicators (World Bank)
- Index of Economic Freedom (Heritage Foundation)
- Economic Competitiveness Index (Institute for Management Development)
- Human Tourism Index (World Travel and Tourism Council)

A more complete list available on web:
http://farmweb.jrc.cec.eu.int/ci/
Examples of composite indicators

**Innovation/Technology/Information**

- Summary Innovation Index (EC)
- Innovative Capacity Index (Porter and Stern)
- Investment/Performance in the knowledge based economy (EC)
- Technology Achievement Index (United Nations)
- The Networked Readiness Index (Harvard University - Centre for International Development)
- E-Government Rankings (World Markets Research Centre)

A more complete list available on web: [http://farmweb.jrc.cec.eu.int/ci/](http://farmweb.jrc.cec.eu.int/ci/)
Examples of composite indicators

Globalisation

- Globalization Index (Foreign Policy Magazine)
- World Competitiveness Index (IMD)
- Growth Competitiveness Index (WEF)
- Current Competitiveness Index (WEF)
- The Globalisation Index (G-Index) (World Markets Research Centre)

A more complete list available on web:
http://farmweb.jrc.cec.eu.int/ci/
General Building Scheme

1. Theoretical framework
2. Data selection
3. Correlation analysis
4. Preliminary data treatment
5. Data normalisation
6. Data weighting
7. Data aggregation
8. Robustness/ sensitivity tests
9. Visualisation
1. Theoretical Framework

Ideally, a theoretical framework will allow indicators to be selected, combined and weighted in a manner which reflects the dimensions or structure of the phenomenon being measured.

Environmental example

What is biodiversity?

Biological diversity - or biodiversity – is usually referred to as the variety of life on earth. This variety is reflected at three levels: in the diversity within species and their genetic composition (genetic diversity), the number of species (species diversity) and the state and function of ecosystems.
2. Data selection

- Policy relevance
- Simplicity
- Validity
- Time series data
- Availability of affordable data
- Sensitivity
- Reliability

An inventory of biodiversity indicators in Europe

- Nature protection (387)
- Forestry (78)
- Energy (1)
- Tourism recreation (4)
- Climate change (12)
- Urban development (4)
- Water (43)
- Transport Infrastructure (11)
- Trade (2)
- Fisheries (22)
- Agriculture (91)

(European Centre on Nature Conservation, February 2002)
3. Correlation analysis

Indicators are often chosen with little attention paid to the interrelationships between them.

Correlation analysis:  
- Identify statistical dimensions in data set  
- Eliminate highly correlated indicators

<table>
<thead>
<tr>
<th>Method</th>
<th>Composite Indicators</th>
</tr>
</thead>
</table>
| Principal Components Analysis  | Environmental Sustainability Index  
|                                | General Indicator of Science & Technology  
|                                | Internal Market Index  
|                                | Business Climate Indicator  
|                                | Success of software process implementation |
| Cronbach Alpha Coefficient     | Success of software process implementation |
| Alpha                          |
4. Preliminary data treatment

- Making variables comparable
  (e.g. dividing by population /income/ populated land area)

- Missing data imputation
  (e.g. data deletion, mean substitution, regression, multiple imputation, nearest neighbour, ignore).

- Logarithms of highly skewed variables
  (e.g. skewness measure greater than 5).

- Truncating distributions
  (e.g. to account for inaccuracy of data at the extremes, to avoid extreme cases becoming benchmarks for entire population.)
## 5. Data normalisation

<table>
<thead>
<tr>
<th>Method</th>
<th>Composite Indicators</th>
</tr>
</thead>
</table>
| **Standard deviation from the mean** | Environmental Sustainability Index  
Mother's Index  
Internal Market Index  
General Indicator of Science and Technology |
| **Distance from the group leader** |                                                                                     |
| **Distance from the mean**     | Economic Sentiment Indicator                                                         |
| **Distance from the best and worst performers** | Human Development Index  
Health System Achievement Index  
Commitment to Development Index  
Human Tourism Index  
The Networked Readiness Index |
| **Categorical scale**          | Environmental Performance Index  
National Health Care Systems Performance  
Business climate indicator  
Index of Economic Freedom  
Summary Innovation Index |
### 6. Data weighting

<table>
<thead>
<tr>
<th>Method</th>
<th>Composite Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equal weights</strong></td>
<td>Summary Innovation Index</td>
</tr>
<tr>
<td></td>
<td>Environmental Sustainability Index</td>
</tr>
<tr>
<td></td>
<td>Composite Leading Indicators</td>
</tr>
<tr>
<td><strong>Correlation analysis</strong></td>
<td>Relative intensity of regional problems in the Community</td>
</tr>
<tr>
<td><strong>Unobserved Components Models</strong></td>
<td>Internal Market Index</td>
</tr>
<tr>
<td>(including PCA/ FA)</td>
<td>General Indicator of Science and Technology</td>
</tr>
<tr>
<td></td>
<td>Business climate indicator</td>
</tr>
<tr>
<td></td>
<td>Governance indicators (Kaufmann, Kraay and Zoid-lobatón, 1999 and 2003)</td>
</tr>
<tr>
<td><strong>Regression analysis</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Data envelopment analysis</strong></td>
<td>Human Development Index (Mahlberg and Obersteiner, 2001)</td>
</tr>
<tr>
<td>(DEA)</td>
<td>Social Inclusion (Cherchye, Mosen, Van Puyenbroeck, 2003)</td>
</tr>
<tr>
<td></td>
<td>Unemployment (Storrie and Bjurek, 1999, 2000)</td>
</tr>
</tbody>
</table>
### 6. Data weighting

<table>
<thead>
<tr>
<th>Method</th>
<th>Composite Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distance to targets</strong></td>
<td>Human Development Index</td>
</tr>
<tr>
<td><strong>Public opinion</strong></td>
<td>Health System Achievement Index</td>
</tr>
<tr>
<td></td>
<td>Commitment to Development Index</td>
</tr>
<tr>
<td><strong>Budget allocation</strong></td>
<td>e-Business readiness index</td>
</tr>
<tr>
<td></td>
<td>Internal Market Index</td>
</tr>
<tr>
<td><strong>Analytic Hierarchy Process</strong></td>
<td>EU New Economy Policy Indicators (NESIS)</td>
</tr>
<tr>
<td></td>
<td>Technology Achievement Index (JRC)</td>
</tr>
<tr>
<td><strong>Conjoint Analysis</strong></td>
<td>Indicator of quality of life in the city of Istanbul (Ülengin et al. 2001)</td>
</tr>
<tr>
<td></td>
<td>Environmental indicators (advocated by Kahn, 1998; Kahn and Maynard 1996)</td>
</tr>
<tr>
<td><strong>Weighting according to missing data</strong></td>
<td>Environment indicators (advocated by Kahn, 1998; Kahn and Maynard 1996)</td>
</tr>
</tbody>
</table>
7. Data aggregation

General formula

\[ Y_c = \sum_{q=1}^{Q} \left( I_{q,c}^p \cdot w_q \right)^{1/p} \]

Composite Indicator value for country \( c \)

Normalised indicator value

compensation effects included

Weight value
8. Robustness/sensitivity tests

1. selection of sub-indicators
2. data selection
3. data editing
4. data normalisation
5. weighting scheme
6. weights’ values
7. composite indicator formula

Sensitivity analysis results

Uncertainty analysis results

- Composite indicator for a given country
- Frequency of occurrence

- Sensitivity analysis results

- Composite indicator formula (12%)
- Selection of sub-indicators (20%)
- Weights’ values (15%)
- Weighting scheme (15%)
- Data selection (25%)
- Data normalisation (5%)
- Data editing (8%)
9. Visualisation

Four-sided pyramid (IISD)

http://www.iisd.org/cgsdi/visuals.htm
9. Visualisation

Elliptical indicator cluster (IISD)

http://www.iisd.org/cgsdi/visuals.htm
9. Visualisation

Compass of Sustainability

http://www.iisd.org/cgsdi/visuals.htm
9. Visualisation

Dashboard Sustainability

http://www.iisd.org/cgsdi/visuals.htm
Conclusions

- Review available indicators within a domain before data selection
- Apply correlations analysis on data
- Apply different data normalisation methods
- Apply different data weighting methods (+ participatory approaches)
- Test robustness of composite indicator values (rankings) to methodological changes
- Communicate composite indicator values (+ indicators’ values)
**Composite Indicators**

An information server on composite indicators

---

**In brief...**

Composite indicators (often called indices) are increasingly used by Statistical Offices and National or International Organizations to convey information on the status of countries in fields such as environment, sustainability, economy, society, or technological development.

This site aims at presenting in a concise way methodologies, case studies, articles, books, software, workshops and any news related to composite indicators.

---

**What's New in 2004**

<table>
<thead>
<tr>
<th>Title/Link</th>
<th>Venue, Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECOND WORKSHOP ON COMPOSITE INDICATORS OF COUNTRY PERFORMANCE</td>
<td>Paris, 26-27 February</td>
</tr>
<tr>
<td>(organisers: OECD / JRC)</td>
<td></td>
</tr>
<tr>
<td>SEMINAR ON NATIONAL BIODIVERSITY POLICY MONITORING AND EVALUATION INDICATORS</td>
<td>Cartagena de Indias, Colombia, 2-4 March</td>
</tr>
<tr>
<td>(organisers: Alexander von Humboldt Biological Resources Research Institute)</td>
<td></td>
</tr>
</tbody>
</table>

---

http://farmweb.jrc.cec.eu.int/ci/