Outline

1. Introduction: Manufacturing and industrial statistics
2. Structural Statistics for Industry
   - UNIDO databases
   - UNIDO Statistical Process
   - Recommended use and limitations of the INDSTAT databases
3. Imputation of key indicators
4. Industrial statistics for business structure
5. Summary and conclusions
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5. Summary and conclusions
Industrial development is a driver of structural change which is key in the process of economic development.

Industrial statistics allow to identify and rank the key production sectors, major economic zones in the country, major size classes.

Specialized and structural statistics on industry (as well as on other economic sectors) are demanded more than ever by researchers and analysts to assess implications of the process of globalization to individual countries:

▶ Synthesized data on world development trends.
▶ Internationally comparable data to assess the growth and structure of one region in the world vis-à-vis others.
▶ A complete set of data on their field of interest to avoid measurement discrepancies.
▶ Regular data production to update/correct policy measures.
The Industrial Sector

In general, industrial statistics are statistics reflecting characteristics and economic activities of the units engaged in a class of industrial activities that are defined in terms of the *International Standard Industrial Classification of All Economic Activities* (ISIC) (IRIS 2008)

The industrial sector corresponds to:

<table>
<thead>
<tr>
<th>ISIC Revision 3</th>
<th>ISIC Revision 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>C Mining and quarrying</td>
<td>B Mining and quarrying</td>
</tr>
<tr>
<td>D Manufacturing</td>
<td>C Manufacturing</td>
</tr>
<tr>
<td>E Electricity, gas and water supply</td>
<td>D Electricity, gas, steam and air conditioning supply</td>
</tr>
<tr>
<td></td>
<td>E Water supply; sewerage, waste management and remediation activities</td>
</tr>
</tbody>
</table>
Section B: Mining and quarrying
This includes the activities relating to extraction of minerals occurring naturally as solids (coal and ores), liquids (petroleum) or gases (natural gas).

Section C: Manufacturing
Manufacturing, according to international recommendations, is defined as the physical or chemical transformation of materials or components into new products, whether the work is performed by power-driven machines or by hand, whether it is done in a factory or in the worker’s home, and whether the products are sold at wholesale or retail.
The Industrial Sector: Sections

Section D: Electricity, gas, steam and air conditioning supply
Economic activities included under this section are the activity of providing electric power, natural gas, steam, hot water and the like through a permanent infrastructure (network) of lines, mains and pipes.

Section E: Water supply; sewerage, waste management and remediation activities
This section includes activities related to the management (including collection, treatment and disposal) of various forms of waste, such as solid or non-solid industrial or household waste, as well as contaminated sites. Activities of water supply are also grouped in this section.
Section C—Manufacturing
Division 10—Manufacture of food products
Group 106—Manufacture of grain mill products, starches and starch products
Class:
- 1061—Manufacture of grain mill products
- 1062—Manufacture of starches and starch products
Main data sources

Information about the domestic production

By ISIC at 3- or 4-digit level (readily available at the National statistical offices).

1. Employment (number of employees)
2. Compensation of employees
3. Gross output
4. Intermediate consumption
5. Value added
6. Gross fixed assets at the end of the reference year and the gross fixed capital formation
7. Index numbers of industrial production
Introduction: Manufacturing and industrial statistics

Main data sources (2)

Foreign trade statistics
Available from e.g. UN COMTRADE.

1. Export of manufactured goods
2. Import of manufactured goods

For an overall assessment of the performance of the manufacturing sector in relation to the economy as a whole, data are needed on the following indicators:

1. Population
2. Gross domestic product (GDP)
3. Manufacturing value added (MVA)
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UNIDO databases

- Cover the industry sector
- Refer to economic statistics, mainly production and trade related, not technological or environmental data
- Include statistical data from the annual observation within the quality assurance framework (no experimental or one-time study data)
- Official data supplied by NSOs (abided by the resolution of UN Statistics Commission)
- Follow the UNIDO Quality Framework (Upadhyaya and Todorov, 2008, 2012)
Industrial statistics databases

Industrial statistics database (INDSTAT/MINSTAT)

- contains annual figures according to industrial sectors (ISIC), country and year
- comprises data for 175 countries; 1963 to the latest available year.
- data are in current prices, national currency; can be presented in current USD

Example: GCC data availability

- Bahrain: 1992—2010 (only 2-digits)
- Kuwait: 2005—2012
- Oman: 1993—2012
- Qatar: 2005—2010 (mainly 2-digits)
- Saudi Arabia: 1996 and 2006
- United Arab Emirates: only total manufacturing in the recent years
INDSTAT/MINSTAT Variables

1. Number of establishments
2. Number of employees
3. Number of female employees
4. Wages and salaries
5. Gross output
6. Value added
7. Gross fixed capital formation
8. Index numbers of industrial production
INDSTAT/MINSTAT Variables (cont.)

- Data for these indicators are readily available in most national industrial census and survey results.
- Data are related \( \Rightarrow \) several other relative variables can be computed:
  - number of employees per establishment,
  - wages and salaries per employee,
  - value added output ratio ...
### Selected Dataset: `INDSTAT 2 2014, ISIC Revision 3, 2-digit`

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<tr>
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<td>9704</td>
<td>10750</td>
<td>12061</td>
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<td>18 Wearing apparel, fur</td>
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<td>9208</td>
<td>9704</td>
<td>10750</td>
<td>12061</td>
<td>10875</td>
<td>11266</td>
<td>11769</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>19 Leather, leather products and footwear</td>
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<tr>
<td>23 Coke, refined petroleum products, nuclear</td>
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<td></td>
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<tr>
<td>24 Chemicals and chemical products</td>
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</tr>
</tbody>
</table>
UNIDO Statistics at the Google Public Data Explorer
Industrial demand supply database (IDSB)

- Data pertain to manufacturing; arranged according to ISIC Revision 3 and 4, at the 4 digit level (127, resp. 137 industries)
- Data are presented by country, manufacturing sector and year.
- Data are derived from output data reported by NSOs together with UNIDO estimates for ISIC-based international trade data (utilizing UN Commodity Trade Statistics Database, COMTRADE)
- Further details: http://www.unido.org/index.php?id=1002106
Industrial demand supply database (IDSB)

- IDSB comprises data for 94 countries; 1990—2012, ISIC Revision 3 and 4. Coverage in terms of years, as well as data items, may vary from country to country depending on data availability.

- Further details:
  
  http://www.unido.org/index.php?id=1002106
Industrial demand supply database (IDSB)

**IDSB Variables**

1. Domestic output
2. Total imports
3. Total exports
4. Apparent consumption
5. Imports from industrialized countries
6. Imports from developing countries
7. Exports to industrialized countries
8. Exports to developing countries.
Industrial demand supply database (IDSB)

IDSB Variables (cont.)

The following relation between the above items exists:

- Total imports = Imports from industrialized countries + Imports from developing countries
- Total exports = Exports to industrialized countries + Exports to developing countries
- Apparent consumption = Domestic output + Total imports—Total exports
MVA Database (MVAExplorer)

- Includes data for GDP and MVA at current and constant prices for around 200 countries and territories from 1990 onwards.
- Compiled from external sources (WDI, UNSD, OECD, etc.)
- Used to estimate the GDP and MVA growth rates, MVA share in GDP, MVA per capita and the MVA structure by world regions
- Augmented with estimates by UNIDO up to the current year based on historical trends (Boudt, Todorov, Updhyaya, 2009)
## UNIDO industrial statistics databases: summary

- **INDSTAT DB**
- **MINSTAT DB**
  - *by ISIC and by country*
  - Number of establishments
  - Number of employees
  - Number of female employees
  - Wages and salaries
  - Gross output
  - Value added
  - Gross fixed capital formation
  - Index numbers of industrial production

- **MVA DB**
  - *by country*
  - GDP at current prices
  - GDP at constant prices
  - MVA at current prices
  - MVA at constant prices
  - Population

- **MVA DB**
  - *by country*
  - GDP at current prices
  - GDP at constant prices
  - MVA at current prices
  - MVA at constant prices

- **IDSB**
  - *by ISIC and by country*
  - Output = \( Y \)
  - Import = \( M \)
  - Export = \( X \)
  - Apparent consumption = \( C \)

\[ C = Y + M - X \]
1. Initialization
   ▶ Pre-filling of the out-going UNIDO General Industrial Statistics Questionnaire with previously reported statistical data and metadata
   ▶ Excel format
   ▶ In the appropriate language - English, French or Spanish
   ▶ Automated using the available data and metadata

2. Data Collection
   ▶ **NSO**: the completed and returned to UNIDO by the NSO questionnaires (excel format, rarely hard copy) are entered into the system and are ready for further validation and processing
   ▶ **OECD**: Data for OECD member countries (excel format) are ready for further validation and processing
3. Transformation/Processing

- The data collected from the primary or secondary sources are further transformed to a ready-to-use data set.
- The data transformation is done in five stages, which not only constitute an operational framework for UNIDO statisticians, but also provides additional description of statistics (generated metadata which are attributed to each data item).
- After undergoing the complete processing phase the incoming and generated data and metadata are stored in the databases.

4. Dissemination

- International Yearbook of Industrial Statistics
- INDSTAT, MINSTAT and IDSB CD and online products
- Web Country Statistics
- Ad hoc requests
Operational framework: stages

- **Stage 1**—responses to national questionnaires. Detection and if possible correction of obvious reporting errors
  - Used for pre-filling the following edition of the questionnaire
  - Data are considered official

- **Stage 2**—incorporation of published national data.
  - Inconsistent data are corrected using supplementary information from national publications
  - Published in International Yearbook of Industrial Statistics
  - Data are considered official
Operational framework: stages

- **Stage 3**—disaggregation of data. Data are adjusted to eliminate the departures from the level of ISIC aggregation
  - using national and international sources
  - using supplementary data
- **Stage 4**—automatic disaggregation and interpolation. Missing data are estimated applying related proportion or interpolation whenever applicable
  - For ISIC Revision 3, 2-digit only
- **Stage 5**—estimation of provisional data for the latest years.
  - Selected variables only
Recommended use of IDNSTAT

- The INDSTAT Database together with detailed international trade statistics provides statistical basis for empirical economic research, for instance, on
  - Manufacturing production and its growth, location and pattern;
  - International trade in relation to manufacturing production, comparative advantage and international specialization;
  - Production factors of manufacturing (e.g., labour, physical capital);
  - Manufacturing productivity (e.g., LP, TFP);
  - Structure (e.g., value-added structure, trade structure, employment structure market structure) of the manufacturing sector.
Limitations of the INDSTAT databases

- **Deviations from ISIC**
  - Data reported (or retrieved) in national classification ⇒ needs to be converted using concordance table
  - Different ISIC revisions ⇒ also needs to be converted using concordance table
  - Many countries report data at a high level of aggregation (3- or 2-digits)
  - Use of a large number of combined ISIC 4-digit categories.

- **Data coverage**
  - incomplete or varying degrees of coverage of establishments (different cutoff points);
  - non-reporting of data by surveyed establishments, and
  - the failure to adjust for non-response.
Limitations of the INDSTAT databases

- **Concepts and definitions**
  - *Employment*: number of employees or number of persons engaged
  - *Wages and salaries*: inclusion of payments to family workers and of employers’ contributions to social security schemes or the exclusion of payments-in-kind.
  - *Output and value added*:
    - difference between the national accounting concept and the industrial census concept (e.g. treatment of non-industrial services); and
    - difference between valuation at producers’ prices, valuation in factor values and other valuations (treatment of indirect taxes and subsidies).
Limitations of the INDSTAT databases

- **Missing data**
  - Incomplete period coverage - significant time lag between data reporting and the latest reference year
  - Incomplete variable coverage
  - Census or survey performed once in, say, five years
  - Missing data for years when changing the ISIC revision
  - Data suppressed due to confidentiality reasons (at 3- or 2-digit level)
  - In many cases it is not clear if the data are missing or are 0s
Limitations of the INDSTAT databases

- Significant differences to other data sets, e.g. the National Accounts MVA database
- Lack of relevant deflators (e.g. for value added) at sub-sectoral levels: does not enable the user to convert properly the available time series on value added at current prices to corresponding time series at constant prices.
- Inconsistency and incoherence of existing indexes of industrial production
- Lack of data by size class
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Imputation in international statistics

Survey data (micro)

- Multiple variables observed for a sample of observation units from a population at one point in time
- Gaps in the data are classified as:
  - Item non-response
  - Unit non-response
  - Variables not included in the survey

Time series data (macro)

- Contain data for multiple time periods
- Contain data for aggregate (or macro) units (sections)
- Sections are usually countries
- Variables are usually statistical indicators (like GDP, MVA, etc.)
Example 1: Estimating the Manufacturing Value Added

Manufacturing Value Added

- **MVA** is the key indicator of a country’s industrial production
- Published in UNIDO’s *International Yearbook of Industrial Statistics*
- Main data source is *World Development Indicators (WDI)* of World Bank
- Data missing for many countries and years
- A time-gap of at least one year (between the latest year and current year)
  - Using data from other sources
  - Nowcasting methods to fill in the missing data up to the current year
Example 1: Using MVA estimates

Overall growth trends of world MVA by selected country groups at constant 2005 prices

Graph showing growth trends of Russian Federation, EU-12, and EU-15.
Table 1.1 DISTRIBUTION OF WORLD MVA AMONG SELECTED COUNTRY GROUPS, 2005-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>EU a/</th>
<th>Other</th>
<th>East Asia</th>
<th>West Asia</th>
<th>North America</th>
<th>Others</th>
<th>Percentage share in world total MVA (at constant 2005 prices)</th>
<th>Percentage share in world total MVA (at current prices)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Europe</td>
<td>Asia and Pacific</td>
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<td>2005</td>
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<td>1.9</td>
<td>1.5</td>
<td>15.5</td>
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<td>0.4</td>
<td>24.1</td>
<td>1.8</td>
<td>1.5</td>
<td>16.4</td>
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<tr>
<td>2007</td>
<td>25.7</td>
<td>2.9</td>
<td>17.8</td>
<td>0.4</td>
<td>23.6</td>
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<td>17.6</td>
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<tr>
<td>2008</td>
<td>25.1</td>
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<td>18.0</td>
<td>0.4</td>
<td>22.2</td>
<td>1.8</td>
<td>1.6</td>
<td>19.0</td>
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<tr>
<td>2009</td>
<td>23.2</td>
<td>2.9</td>
<td>17.0</td>
<td>0.4</td>
<td>21.7</td>
<td>1.9</td>
<td>1.6</td>
<td>22.1</td>
</tr>
<tr>
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<td>18.3</td>
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<td>1.7</td>
<td>1.6</td>
<td>22.7</td>
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<td>2012 b/</td>
<td>22.5</td>
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<td>17.2</td>
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<td>1.6</td>
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<td>23.7</td>
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<td>2014 c/</td>
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<td>2010</td>
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<tr>
<td>2011</td>
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<tr>
<td>2012 b/</td>
<td>18.9</td>
<td>3.6</td>
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<td>18.2</td>
<td>1.9</td>
<td>1.9</td>
<td>31.2</td>
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</tbody>
</table>

a/ Excluding non-industrialized EU economies.
b/ Provisional.
c/ Estimate.
Example 1: GCC data availability

GDP and MVA at 2005 constant prices, GDP and MVA at current price and population for the GCC countries in 2010 (million USD)

<table>
<thead>
<tr>
<th>country</th>
<th>gdpcod</th>
<th>mvacod</th>
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<th>mvacud</th>
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<tbody>
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<td>28934786</td>
<td>8441537</td>
</tr>
</tbody>
</table>

- The numbers shown in red are not available in the World Bank database and were compiled by UNIDO.
Example 2: Reclassification

- Some countries do not use standard international classifications (e.g. ISIC/NACE classification of economic activities) or
- do not provide historical data on this basis or
- we need a long time series but the world changes and new revisions of the standard classification are adopted:
- ⇒ Data are converted according to a mapping of different classification systems. Where the mapping is not a clear-cut one to one basis, this introduces an element of imputation.

<table>
<thead>
<tr>
<th>Revision</th>
<th>From</th>
<th>Available</th>
<th>UNIDO</th>
<th>Comment</th>
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<td>1963-2004</td>
<td>INDSTAT 3</td>
<td>discontinued in 2006</td>
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<td>1990</td>
<td>1990-2012</td>
<td>INDSTAT 4</td>
<td>3- and 4-digits</td>
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<td>2005-2012</td>
<td>INDSTAT 4</td>
<td>3- and 4-digits</td>
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<td>1990</td>
<td>1963-2012</td>
<td>INDSTAT 2</td>
<td>2-digits, data imputed</td>
</tr>
</tbody>
</table>
Example 3: Studying the Structural changes in manufacturing

- **Structural change**
  - *Structure or Structural change* have become widely used in economic research, however with different meanings and interpretations
  - The most common meaning refers to long-term persistent shifts in the sectoral composition of economic systems.
  - Patterns of industrial production and international trade are two sides of one coin: they both reflect the level and the structure of industrial activity in a country.
  - Detailed and relatively complete structural statistics for international trade data are readily available from UN COMTRADE.
  - We need similarly detailed and complete structural statistics for industrial production: UNIDO INDSTAT.
Example 3: Studying the Structural changes in manufacturing

Share of manufactured exports in total exports (in per cent)

![Bar chart showing the share of manufactured exports in total exports for Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and UAE in 2000 and 2009.](chart)

Source: UN COMTRADE and UNIDO Database
Example 3: Studying the Structural changes in manufacturing
A. Nowcasting MVA

- GDP data are available up to the current year:
  - For earlier years the actual GDP values are used
  - For the most recent one or two years the GDP values are derived from the nowcasts of GDP growth rates reported in the *World Economic Outlook of IMF* (see Artis, 1996)

- MVA—a time-gap of at least one year: nowcasting

- MVA is strongly connected to the GDP

- ⇒ this suggests to nowcast MVA on the basis of the estimated relationship between contemporaneous values of MVA and GDP
A. Nowcasting MVA—the model

- We consider models based on the following general representation of MVA:

\[
MVA_{i,t} = MVA_{i,t-1}(1 + g_{MVA_{i,t}})
\]

where the MVA growth rate is modelled as

\[
g_{MVA_{i,t}} = a_i + b_i g_{GDP_{i,t}} + c_i g_{MVA_{i,t-1}} + e_{i,t}
\]

and \(e_{i,t}\) is white noise.

- This general model can be specialized down to four different models (see Boudt, Todorov and Upadhyaya, 2009)
B. Imputation INDSTAT: Cross-sectional time series data

- **Four different types of time series data structures** (Denk and Weber, 2011):
  1. Single univariate time series
  2. Single multivariate time series
  3. Cross-sectional univariate time series
  4. Cross-sectional multivariate time series

- **Missingness patterns** The relevance and applicability of missing data techniques depends on:
  1. missing items;
  2. missing periods,
  3. missing variables, and
  4. missing sections (countries).
B. Imputation INDSTAT: Description of the data set

Variables of interest
1. GO - Gross output
2. VA - Value added
3. WS - Wages and salaries
4. EMP - Number of employees

Auxiliary variables
1. IIP - Index of Industrial Production
2. MVA - Manufacturing Value Added (from SNA)
3. IMVA - Index of MVA
4. CPI - Consumer price index
B. Imputation INDSTAT: Description of the data set

The following variables will not be considered:

- GFCF - Gross fixed capital formation—the economic relation to GO and VA is too weak
- EST - Number of establishments—too heterogeneous due to difference in definitions
B. Imputation INDSTAT: Deterministic approach based on economic relations

- Impute the four variables of interest using economic relationships between the variables.
- Start with estimation of the missing observations for Gross output based on available production indexes or Value added.
- Estimate Value added, Wages and salaries and Employment on the basis of past trends in the relationships between output and these three variables.
  - (a) At total manufacturing level.
  - (b) Share-based allocation of manufacturing totals.
B. Imputation INDSTAT: Example 1: Egypt

Imputation of all missing values using IIP and CPI
B. Imputation INDSTAT: Example 2: imputation by industry
Outline

1. Introduction: Manufacturing and industrial statistics

2. Structural Statistics for Industry
   - UNIDO databases
   - UNIDO Statistical Process
   - Recommended use and limitations of the INDSTAT databases

3. Imputation of key indicators

4. Industrial statistics for business structure

5. Summary and conclusions
Industrial statistics for business structure

- National accounts to show the overall economic growth; business structure data to reveal the growth potentials
- Industrial statistics allow to identify and rank the key production sectors, major economic zones in the country, major size classes
- Employment and wage rate; share of compensation of employees in VA
- Productivity, capacity utilization and other indicators of economic performance
- Environment; use of cleaner energy; waste disposal system and water treatment
Measuring the industrial performance

- **Industrial performance** is an outcome of various social, economic and technological factors. The three most important dimensions of industrial performance are:
  - Productivity,
  - Structural change and
  - Competitiveness

- **Performance indicators**
  - Performance indicators make it possible to evaluate performance (like, profitability, productivity and efficiency) of producers units.
  - In principle, a performance indicator is a policy relevant statistics that provides an indication about the conditions and functioning of any segment of the economy.
The performance indicators can broadly be distinguished under three types, namely:

1. growth rates,
2. ratio indicators, and
3. share indicators.

These indicators may be calculated at the 3-digit (group) level for annual and at 2-digit (division) level of ISIC, Rev.4 for quarterly periodicity.
Measures of productivity growth constitute core indicators for the analysis of economic growth. The indicators of productivity are highly demanded by policy makers. Construction of these indicators is based on the relation of different output and input components at the national, industrial sector, and enterprise levels:

1. MVA per capita
2. Value added per employee
3. Value added per hour worked
4. Value added per unit of capital
5. Capital per employee
6. Multifactor productivity index
7. Value added output ratio
MVA per capita in the UN ESCWA member countries

- Values in USD (log scale)
- Data refer to year 2012 except Palestine (2011) and Syria (2010)
- Data source: UNIDO Statistics
MVA per capita in the UN ESCWA member countries

- Values in USD (log scale)
- Data refer to years 2001 and 2012 except Palestine (2011) and Syria (2010)
- Data source: UNIDO Statistics
MVA per capita on the map (UN ESCWA member countries)
Industrial statistics for business structure

Structural change

- **Structural change**
  - Structures of MVA as well as international trade reflect the country’s comparative advantages which depends mainly on the country’s endowments of production capitals, low-wage labor and natural resources as industrial materials.
  - The principal indicators are measured as the shift of sector shares over a considerable interval of time.

- **Shares and growth**
  - *Structural change* is closely connected with *industrial growth*. On the one hand, structural change may accelerate growth while, on the other hand, any growth may result in significant structural change.
  - Both shares and growth indicators have to be considered.
Measures of Industrial structure

1. Change in sector share
2. Coefficient of absolute structural change
3. Coefficient of relative structural change
4. Integral coefficient of structural change
5. Rank correlation
6. Coefficient of diversification
7. Regional disparity index
8. Position of manufacturing in economy (share of MVA in GDP)

- Indicators 1-5 consider shift in the shares in a certain period.
- Indicators 1-7 provide statistics for analysis of structural change within the manufacturing industry.
- Details about the computation of the indicators can be found in Industrial Statistics—Guidelines and Methodology
The coefficient of diversification shows the extent to which the production is spread across different manufacturing branches and is based on the share of manufacturing branches in total output.
Structural change

- UNIDO Database is mainly the collection of business structure statistics and provides detail information for structural change analysis.
- A number of classifications derived from ISIC are used to indicate the structural composition and its change over time:
  - Agro-based sectors
  - Resource based-sectors
  - Sectors by technological intensity
  - Sectors by energy intensity
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Summary and conclusions

• UNIDO Statistics mandate: maintain global industrial statistics databases
  ▶ INDSTAT 2 at 2-digit level of ISIC Revision 3
  ▶ INDSTAT 4 at 3- and 4-digit level of ISIC Revision 3 and 4
  ▶ MINSTAT at 2- and 3-digit level of ISIC Revision 3 and 4
  ▶ IDSB at 4-digit level of ISIC Revision 3 and 4
  ▶ MVA

• Data quality framework

• Dissemination: online data portal, CD Roms, printed publications

• UNIDO Statistics business process: aligned to GSBPM

• Improve quality and coverage:
  ▶ Technical cooperation projects

• A number of derived databases