

Visual Aggregation of a Sustainable Development Indicators System (MONET)

Boesch, Anne

Swiss Federal Statistical Office, Unit Environment, Sustainable Development, Territory

Espace de l'Europe 10

2010 Neuchâtel, Switzerland

E-mail: anne.boesch@bfs.admin.ch

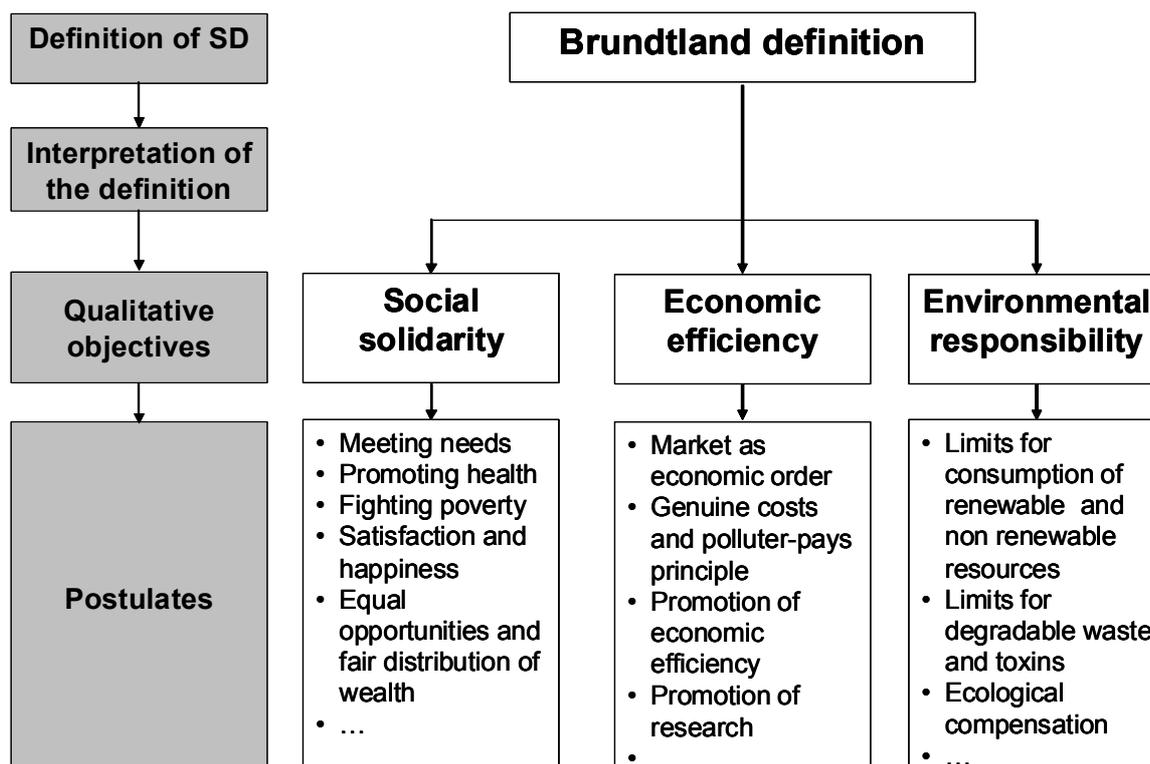
Sustainable development is a complex and normative notion that is far from being understood the same way by everyone. The aim of sustainable development indicators systems such as MONET is to contribute to reduce complexity and facilitate communication by structuring statistical information and providing a common understanding of the observed phenomenon. Such indicators systems are usually still too extensive, however, to be easily accessible by a large audience. One possibility to solve this problem is to synthesize and aggregate the information, which requires a robust and transparent framework to rely on.

This paper begins with a short introduction on the construction and structure of the Swiss sustainable development indicators system MONET. It then presents how the framework of the MONET system allows making extracts of indicators, inter alia for the monitoring of the Swiss Federal Council's Sustainable Development Strategy, for which 55 indicators from the MONET system are used. In a third part, the synthesis of information by means of the assessment of indicators is presented. The dashboard of sustainable development, which offers a visual aggregation of the MONET indicators used for the monitoring of the Sustainable Development Strategy, is then introduced and commented with a view to bring new inputs in the discussion on aggregation of complex information such as sustainable development and on the role of participative methods in these kinds of approaches.

Starting point: the MONET sustainable development indicators system

The MONET sustainable development indicators system aims to monitor sustainable development in Switzerland (MONET is the German acronym for "Monitoring sustainable development"). It informs about the current situation and about trends in the environmental, economic and social dimensions of sustainable development. The conceptual framework of the MONET system rests upon a frame of reference and a systemic structure (de Montmollin & Scheller 2007; FSO, SAEF, ARE 2004).

The frame of reference is based on the original definition of sustainable development set forth in the report of the World Commission on Environment and Development (also known as the Brundtland report) (WCED 1987), which is interpreted drawing on human rights principles and the theory of justice propounded by John Rawls in 1978. The definition is broken down into three qualitative objectives: "Social solidarity", "Economic efficiency" and "Environmental responsibility". These objectives are themselves concretized in 45 sustainable development postulates. This three-step operationalization of the definition of sustainable development leading to the frame of reference is described in figure 1. Each postulate is clearly and directly linked to the main elements of the interpreted definition of sustainable development (intra- and intergenerational justice, maintenance of options, meeting of needs, finite natural resources), as well as to the three qualitative objectives. The postulates are geared to the long term; no attempt is made to solve specific, current problems. They set directions to be followed in order to achieve sustainable development. Such a frame of reference ensures coherence and clarity as well as a certain balance between the numerous facets of sustainable development.

Figure 1: Frame of Reference

The systemic structure provides a logical and systematic framework from which indicators can be chosen. It takes the form of a matrix comprising two axes: a thematic and a procedural one. The thematic axis is made up of the twelve themes that are the gateway to the system. The procedural axis is based on an indicator typology describing the processes relevant to sustainable development. The typology is based on an extended stock-flow model that is illustrated in figure 2. This model comprises the following elements (types of indicators):

1. Capital (status and potential of resources – environmental, economic and social)
2. Level (extent to which the needs of individuals and society are met)
3. Input/Output (flows to, or from, the capital to meet the needs of individuals and society)
4. Structural Criteria (extent to which the capital is used in an equitable and efficient manner)
5. Response (social and political measures taken to counter undesired developments)

Each indicator corresponds to one of these types. Combining different types of indicators within one theme allows complex statements to be made on this particular theme and prevents arbitrary assessments of the observed developments. All five types are based on the Brundtland definition (report of the World Commission on Environment and Development) and our interpretation of this definition. The typology is a procedural interpretation, whereas the postulates mentioned above are an interpretation of the content of this definition. The types of the indicators are not used for communication, they are meant to guide the indicator selection process in order to ensure the most complete and neutral understanding of the given theme as possible.

The indicators of the MONET system were originally selected in a participatory manner by involving around 80 experts from 20 different federal offices. The aim was to tap into expertise from many different disciplines, raise awareness of sustainable development concepts and favour the use of indicators within the Federal Administration. In order to prevent horse-trading, the experts had to respect various prerequisites, such as selection criteria for the indicators (e.g. each indicator must be linked to at least one of the 45

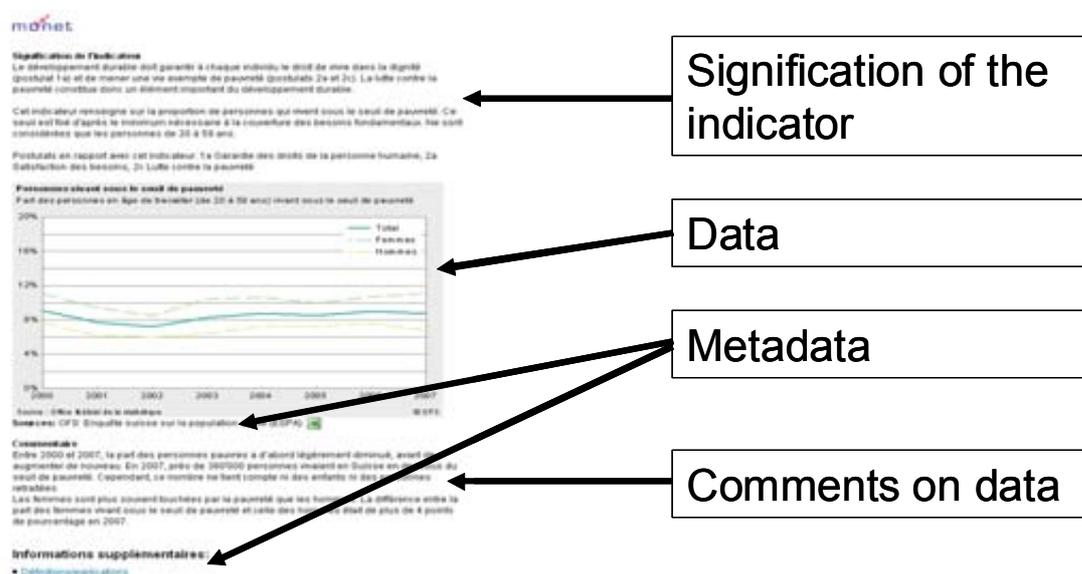
elements correspond to the indicator types “Capital” and “Structural criteria” of the systemic structure, the selection of the indicators to monitor the SDS from the whole MONET system was relatively simple (only indicators of these types were retained). Moreover, because the federal offices involved in the SDS – and hence in the selection of indicators to monitor it – had participated in the construction of the MONET system and were rather familiar with it, the discussions about the choice of indicators went well.

While the whole MONET system aims at monitoring sustainable development as objectively and independently as possible, the selection of the 55 indicators for the monitoring of the SDS relies on the 11 thematic action areas of the strategy and was therefore influenced by the importance given to specific themes at the level of the federal sustainable development policy. Indicators of the environmental and economic dimensions are overrepresented in the selection dedicated to the monitoring of the SDS in comparison to the whole MONET system where the share of indicators from the social dimension is greater. If other thematic action areas had been defined for the SDS, the indicators chosen to monitor them would have been different.

A first step towards synthesizing information: the assessment of the indicators

Each MONET indicator is made up of the same elements, which are shown in figure 3. The first element (signification of the indicator) explains why the indicator has been chosen and what it should illustrate, and is based on the postulates the indicator is linked to. The data of the indicator – a time series, since we aim to monitor sustainable development – is shown on a graph in a second element (it is also downloadable as an Excel sheet). The third element consists of a comment about the evolution of the indicator. The source of the data is indicated below the graph, and further metadata (for example definitions, etc.) are presented in a second page, not shown in figure 3.

Figure 3: Structure of an indicator



This systematic and transparent presentation of the indicators helps the user find his or her way into the system, but the connection between the various elements to know whether a given indicator is evolving towards sustainable development is not straightforward. This is the reason why a first synthesis is made by comparing the observed trend of each indicator with the trend it should follow according to the postulate(s) it is related to. For example, the indicator “Official Development Assistance” should increase according to the postulate 6a “Development cooperation”. The observed trend is indeed increasing, and the indicator is therefore assessed positively. Each indicator of the MONET system is thus attributed an evaluation that is

either positive, negative or neutral. Such an indicator-based assessment is delicate to carry out for a national statistical institute and is possible only because the whole assessment process is transparent: both the underlying data and the postulates to which the indicator is connected are shown.

Visual Aggregation of indicators: the dashboard of sustainable development

The 55 indicators chosen to monitor the SDS already constitute a reduction of information in comparison to the whole system with its 80 indicators, but such a number of indicators is still difficult to apprehend and may not reach the politicians, policy-makers and the general public who are the target audience of the sustainable development indicators selected to monitor the SDS. These groups should have the possibility to know at a glance whether Switzerland is on the path towards sustainable development, without even having to leaf through a document. A further step is therefore required to simplify the information.

Before taking any concrete actions, it is important to set the aims one wants to achieve by simplifying the information. We identified the following aims:

- Allow a global judgment of the situation (zoom out from the individual indicators)
- Keep an overview of the whole system (maintain a high resolution - at the level of the indicators and groups of indicators)
- Remain transparent

There are several possibilities to simplify the information, such as key indicators, a synthetic index, or a dashboard. Key indicators emphasize the main trends and reveal critical obstacles on the path towards sustainable development (Boesch et al. 2009). As such, they allow a global judgement of the situation, but they do not offer the possibility to keep an overview of the whole system. A synthetic index would provide some kind of global judgement, but it would be difficult to identify the contribution of each indicator in the final, unique figure, which diminishes the transparency and does not offer the possibility to keep an overview of the whole system. The dashboard approach, which is presented in the following paragraphs, emerged as the best solution.

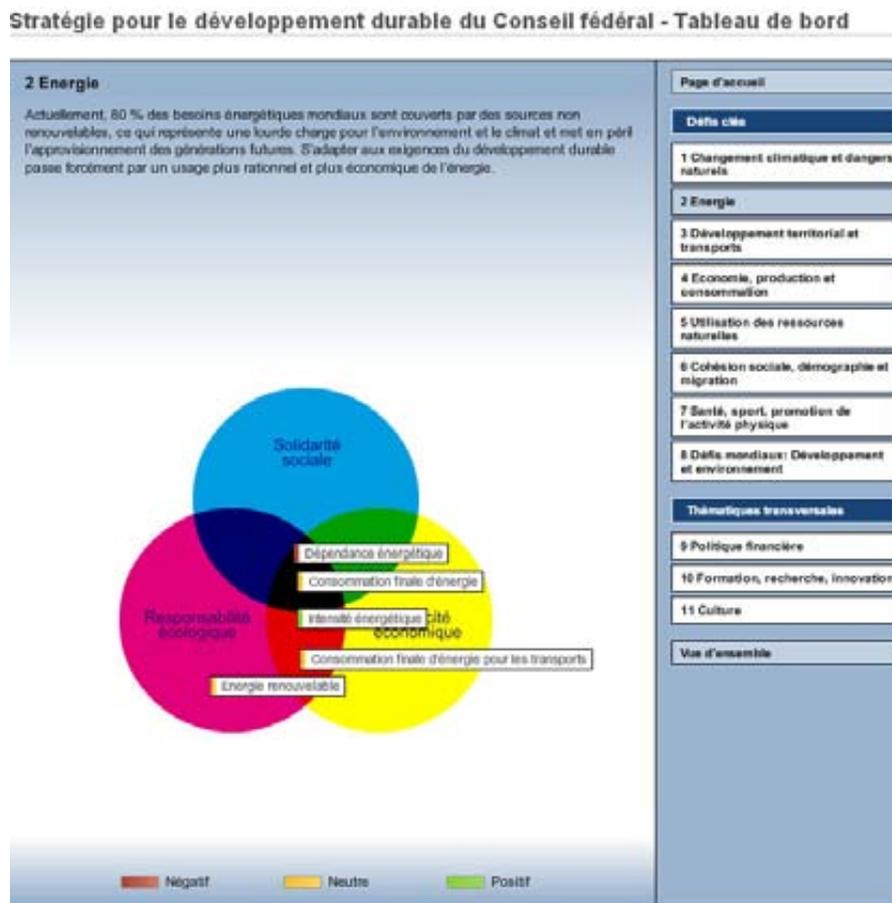
Constructing a dashboard necessitates a common unit for all the indicators. The 55 indicators selected to monitor the SDS are indeed of different natures and have different units. Moreover, they deliver information about the evolution of phenomena related to sustainable development and were not designed to inform about the current state of a given phenomenon. One distinctive feature of the MONET system turned out to be particularly useful in this regard: the assessment of indicators. As mentioned above in the section “A first step towards synthesizing information: the assessment of the indicators”, each indicator is attributed an evaluation that is either positive, negative or neutral and that has a common unit (dimensionless)

Based on these reflections and, among other preliminary work, on the outcomes from an international conference on visualisation held at the FSO in 2005 (Visualising Indicators, 2005), the dashboard was launched in 2007.

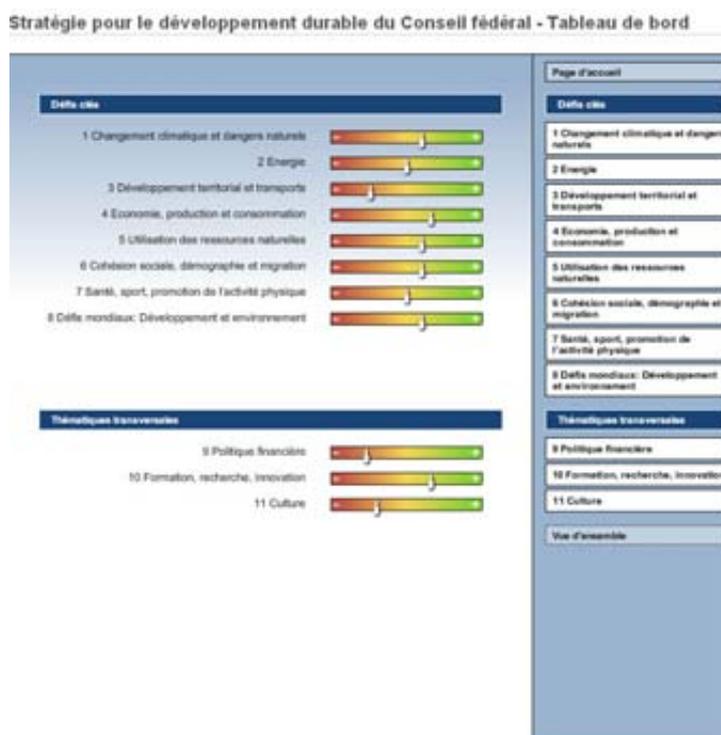
The starting page of the dashboard (figure 4) displays the main conceptual elements of the monitoring of the SDS. The three-circle diagram illustrates the sustainable development processes (or indicator types) that are relevant for the selection of indicators to monitor the SDS. The circles themselves represent the stocks of environmental, social/human and economic capital, whereas the interaction between the “economic” and “environment” circles represents the notion of efficiency (in the use of environmental stocks), and the interactions between the “environment” and “social” circles as well as between the “economic” and “social” circles represent the notion of equity (in the access to environmental and economic resources). Both equity and efficiency constitute the indicator type “Structural criteria”. The three-circle diagram is also a reference for the Sustainable Development policy in Switzerland that is promoted by the SDS (part of a three-dimensional model that also includes the north-south perspective and the present and future generation perspective).

The right side of the starting page lists the 11 thematic action areas of the SDS. It is possible to situate the indicators selected for the monitoring of each area in the three-circle diagram by passing the mouse over the name of the area. The colour on the left side of the label of the indicators on the three-circle diagram represents their assessment (green for positive, yellow for neutral and red for negative).

Figure 4: Starting page of the dashboard of sustainable development



The overview (“vue d’ensemble”) page of the dashboard (figure 5) presents the results of the assessment of the 11 thematic action areas, thus allowing a global judgement of the situation. Each bar, representing the assessment of each thematic action area, can be considered as a composite indicator. Such an overview makes it possible to take into account simultaneously the information on very different but equally important domains such as energy, social cohesion or innovation. The idea behind the dashboard of sustainable development is similar to the one behind an aircraft dashboard. The pilot does not just want to know the outside temperature, the speed, the altitude or the remaining fuel, but whether these elements fit together so that the plane is going to land at the right airport at the right time. The same applies in the case of sustainable development: it is important that the various components that characterize a sustainable development all evolve in the right direction so that sustainability is effectively achieved.

Figure 5: Overview page of the dashboard of sustainable development

Transparency in the dashboard is ensured by the fact that it is possible, in analogy with a car or plane dashboard, to look behind the various dials, for example in order to investigate the causes of a failure. In the dashboard of sustainable development, this means that it is possible to look behind the assessment of each of the 11 thematic action area ("composite indicator") presented in the overview page of the dashboard. One accesses the other side of the dials (the thematic action area) by clicking on any of the areas listed on the right side of the dashboard. Figure 6 shows how the page of each thematic action area is structured. Firstly, it is possible to know what indicators are used for the monitoring of each of the thematic action areas (as mentioned above, each thematic action area is monitored by five MONET indicators) and, more importantly, how each indicator contributes to the assessment of the thematic action areas. This possibility of "zooming in", combined with the fact that the list of the 11 thematic action areas is always available on the right side of the dashboard, also ensures that the objective of maintaining an overview of the whole system is reached.

The contribution of each indicator is based on a very simple mathematical aggregation: if its assessment is positive, it is allocated the value "+1", if it is negative, the value "-1" and if it is neutral, the value "0". Each indicator has the same weight (1). This simple mathematical aggregation is made visual by representing it as the position of a pointer on a bar, which ranges from -5 to +5. Whereas figure 6 shows the static result of the assessment for one thematic action area, the user actually sees the pointer starting in the neutral "zero" position in the middle of the bar and then moving one unit to the right (+1) in case the first indicator listed is assessed positively, or one unit to the left (-1) if the assessment is negative, or not moving (0) if the assessment is neutral. The same principle applies to the second, third, fourth and fifth indicators, until the pointer reaches the final position on the bar, which is the result displayed in the overview page of the dashboard.

The dashboard of sustainable development further promotes transparency in the sense that it is not only possible to know which indicator contributes to the assessment of one particular thematic action area and how. The user can access a graph that shows the time series that is assessed by clicking on the title of the indicator in the list of the thematic action areas detail page. A further click on the link "further information" ("informations supplémentaires") on the right below the graph leads to the indicator page (see figure 3). The

user therefore has the possibility to reconstruct the whole process of aggregation of the information, starting with the data of each of the 55 indicators selected to monitor the SDS and ending with the overview page that shows the result of the assessment of each thematic action area.

Figure 6: Thematic action area detail page in the dashboard of sustainable development



Discussion

The fact that an equal weight is attributed to each indicator and that each thematic action area is measured by the same number of indicators (five) is not based on complex theoretical fundamentals, but rather on a very pragmatic approach. More sophisticated methods could have been used to set up a weighting scheme, for example on the basis of a participatory process, or of scientific publications. What we consider most important, however, is to be transparent about the weight of each indicator, whatever it is. In practice, not every thematic action area can be measured by five indicators (due to a lack of data or the revision of an indicator). This means that the remaining indicators have a greater impact on the overall result shown in the overview page than indicators in thematic action area for which five indicators are available.

The structural elements used in the aggregation process, which are here the thematic action areas, have an influence on the result. Their choice is also pragmatic, as they were taken over from the SDS.

While the visual aggregation is possible thanks to the fact that the indicators are assessed based on their evolution, it is not possible to follow the evolution of the dashboard. One could imagine, in analogy with the painter Claude Monet, who made several paintings representing the same place at different times, that a “time function” could be added to the dashboard of sustainable development, so that the user could follow the evolution of the assessment of the 11 thematic action areas. The dashboard would not be a picture anymore, but a movie showing in an aggregated manner whether the trends of the indicators are improving or on the contrary getting worse in relation to sustainable development.

By simplifying the information, the dashboard underlines the weaknesses associated with the use of indicators. For example, users tend to think that the position of the pointer on the bar means that the current status of the underlying indicators is bad (in case of a negative assessment) or good (in case of a positive assessment), whereas the assessment is not based on the status of the indicator, but on its evolution. It is not

the current status that is bad or good, but the evolution over time. This is particularly disturbing in the case of indicators for which target values have been defined and are well-known, such as the “greenhouse gas emissions” indicator. A positive assessment for this indicator does not mean that the Kyoto target has been reached, but that the indicator is evolving in the right direction in order to reach the target. A user who knows about the Kyoto target but who is not aware of how the assessment has been carried out may be confused. This information is not the most easy to find in the whole MONET system neither, but since all the components of the indicators described in figure 3 are available, it is an easier process. In the dashboard, on the contrary, the information is aggregated to the point that even no graph is shown in the first place, rendering the problem associated with the communication of indicator assessment more prominent.

Conclusion

As to the weighting of the indicators, we are aware that our weighting scheme is extremely simple but, as mentioned above, what we consider to be most important is the transparency of how the weighting, and the aggregation process in general, has been carried out. The construction of the dashboard itself and the choice of the weighting scheme were not carried out in a participatory manner, but they rely on the MONET sustainable development indicators system, which involved 80 experts from various units from the Swiss federal administration for its creation at the beginning of the years 2000, and about 50 for its revision in 2009. A more participative approach should therefore begin, in our opinion, with the whole MONET system (for example by involving representatives from civil society), and should not be restricted to the dashboard.

The dashboard of sustainable development developed and implemented at the Swiss Federal Statistical Office is, to our knowledge, the first published attempt to aggregate the information provided by a sustainable development indicators system. It should by no means be considered to be a fixed solution, but rather an evolving process. The evolution draws among others on feedbacks by users (collected for example by means of an internet survey), or by peers on the occasion of meetings or conferences.

One of the comments we heard several times about the dashboard of sustainable development is that since we already went as far as aggregating information into what can be considered to be 11 composite indicators, we could envisage going one step further and aggregating these into a single composite indicator. The advantage of such a single figure would be a substantial increase in visibility. But this would mean going back to the synthetic index solution that was rejected in favour of the dashboard for transparency reasons and because it did not allow maintaining an overview of the whole system. To make an analogy with the painter Claude Monet, the MONET indicators system and the dashboard of sustainable development derived from it remain an impressionist painting of sustainable development. If all the colours of the painting were mixed, we would switch from the impressionist style to the monochrome style, like Kasimir Malevich’s paintings.

REFERENCES

Boesch Anne, Wachtl Jana, de Montmollin André. Towards Key Sustainable Development Indicators: the Swiss Approach. Paper presented at the 57th Session of the International Statistical Institute in Durban, 2009.

<http://www.statssa.gov.za/isi2009/ScientificProgramme/IPMS/0989.pdf>

de Montmollin André and Scheller Andrea. MONET indicator system: the Swiss road to measure sustainable development. *Int. J. Sustainable Development*, Vol. 10, Nos 1/2, 2007.

FSO, SAEF, ARE. Monitoring sustainable development MONET – final report. Methods and results. Neuchâtel, 2004. <http://www.bfs.admin.ch/bfs/portal/en/index/themen/21/22/publ.html?publicationID=1598>

Swiss Federal Council. Sustainable Development Strategy: Guidelines and Action Plan. Bern, 2008.

<http://www.are.admin.ch/themen/nachhaltig/00262/00528/index.html?lang=en>

Visualising Indicators – International Conference on “Visualising and Presenting Indicator Systems”. Held at the Swiss Federal Statistical Office in Neuchâtel, 14-16 March 2005.

<http://www.bfs.admin.ch/bfs/portal/en/index/themen/21/11/visu.html>

WCED. Report of the World Commission on Environment and Development: Our Common Future. New York, 1987.
<http://www.un-documents.net/wced-ocf.htm>

RÉSUMÉ

The Swiss Sustainable Development Indicators system MONET (German acronym for "Monitoring Sustainable Development") encompasses about 80 indicators, 55 of which are used to monitor the Federal Council's Sustainable Development Strategy (SDS). Each indicator is assessed positively, neutrally or negatively according to whether the observed trend is evolving towards Sustainable Development or not. This represents a lot of information, and the challenge faced by an indicator system such as MONET is to find a way to provide an overview that is easily understandable by the general public and by policymakers without losing transparency.

The approach that has been used until now is a visual aggregation method called Dashboard (or Cockpit), in analogy with a car dashboard or aircraft cockpit. It is applied to the 55 indicators dedicated to the monitoring of the Swiss SDS. The Dashboard is a simple method that allows the aggregation of indicators with various units (by means of the assessment of their trend) and provides a synoptic view of the whole system as well as an overall assessment of the situation. At the same time, the Dashboard gives access to each individual indicator, thus allowing detailed information to be displayed and achieving transparency.

The experiences made with the Dashboard of Sustainable Development raise a number of issues that are relevant for the discussion about the construction of composite indicators. These include the balance between transparency and simplicity, the weighing process, the importance of structural elements, and the influence of Sustainable Development policies on these elements through the Swiss SDS.