Chapter 9
An Operational Monitoring Tool

Abstract The transition from an urban brownfield to a sustainable neighbourhood is a complex operation. To help decision-makers reach sustainability objectives through measurement, follow-up, and communication about performance indicators, we introduce in this chapter a tailor-made operational monitoring tool. Such a tool should satisfy three general requirements: a search for overall quality, adequacy with the specificities of urban brownfield regeneration projects, and integration into the project dynamics. Accordingly, the multi-criteria evaluation system SIPRIUS and the quality management monitoring software OKpilot are hybridized to create SIPRIUS+. In the first section, we explain the functioning of the two existing methodologies and the adaptions we made to help meet the general requirements and to create the hybrid tool. Then, we present the resulting monitoring tool, SIPRIUS+, and its functionalities.

Keywords Operational monitoring tool · Hybridization · Sustainability indicators · Multi-criteria evaluation · Quality management · Monitoring software · SIPRIUS+

9.1 The Hybridization of Methodologies

Urban brownfield regeneration projects are opportunities to create new sustainable neighbourhoods within metropolitan areas. Because of the overall complexity of these neighbourhoods in transition, we previously argued that a tailor-made operational monitoring tool was required to integrate sustainability objectives, ensure their implementation, measure their performance, and communicate about their results. The tool should satisfy three general requirements: first, a search for overall quality (the tool must equally assess the economic, environmental, social, and institutional/governance dimensions of sustainability); second, adequacy with the specificities of urban brownfield regeneration projects (the tool must be specific to urban brownfield issues as well as the regeneration project process, in particular, its multidisciplinary aspect); and third, an integration into the project dynamics (the tool must include ex-ante, in itinere, and ex-post evaluation as well as promote continuous follow-up and improvement of the project).

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Chapter 8 reported some evaluation methods adapted to brownfield regeneration projects, which meet the general requirements to some extent. However, the critical analysis revealed that these methods are dissociated from the overall project dynamics. In other words, they are not operational and fail at monitoring sustainability objectives.

In response to this common major failure, a research project, conducted at Ecole polytechnique fédérale de Lausanne (EPFL),[1] allowed the development of a new operational monitoring tool tailored to issues raised by urban brownfield regeneration projects. Called SIPRIUS+, the tool is based on a hybridization strategy relying on the potential of existing knowledge and expertise. Hybridization offers the possibility of combining different techniques to compensate for the complexity of decision-making in a world where information is varied and sometimes contradictory (Zavadskas et al. 2016). It puts elements of different origin in synergy and collaboration in order to obtain a combined function that is more efficient and user-friendly. Hybridization requires adapting the two parts sufficiently to make them compatible with each other while remaining identifiable separately (Battilana et al. 2012). Creating new hybrid tools is part of transdisciplinary research (td-net and Swiss Academies of Arts and Sciences 2017). Close to our concerns, Glaeser paraphrases Janes Jacob's motto, "New ideas need old buildings", and transforms it into "New ideas are formed by combining old ideas" (Jacobs 1961; Glaeser 2011).

Thus, SIPRIUS+ originates from the hybridization of existing methodologies from different fields: the built environment and quality management. While sustainability considerations and associated indicators may differ, the methods used to monitor objectives in business or project development are considerably similar. An extensive analysis led us to the complementary selection of SIPRIUS, a multi-criteria evaluation system specifically designed to integrate sustainability into the dynamics of urban brownfield regeneration projects (see Chap. 8), and OKpilot, a web-based quality management monitoring software for public and private organizations (Laprise et al. 2018). Based on their inherent assets, the initial hypothesis was that, put together, they could fulfil the previously described requirements (Fig. 9.1).

This chapter describes the two methodologies and presents the adaptations that were required before performing the hybridization. Then, it describes the main functionalities of SIPRIUS+.

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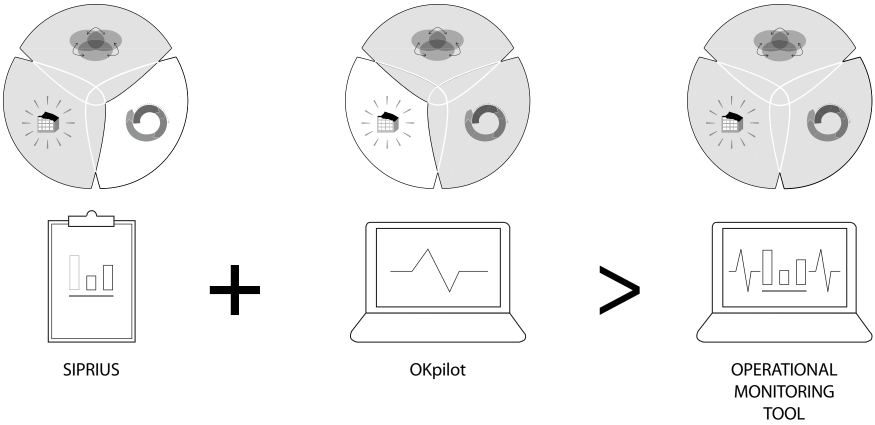

Fig. 9.1 Hybridization of the multicriteria evaluation system SIPRIUS and the quality management monitoring software OKpilot to create SIPRIUS+

9.2 The Multi-Criteria Evaluation System

9.2.1 Description

SIPRIUS is a multi-criteria evaluation system adapted to urban brownfield regeneration projects reflecting the Swiss context (Rey 2012). It develops criteria and indicators according to a holistic approach, based on a definition of the fundamental objectives of sustainable development (Rey 2006). It also includes methodological considerations for assessment and measurement (Pintér et al. 2012), seeking exhaustiveness but non-redundancy.

The criteria—and the associated indicators—cover environmental, sociocultural, and economic aspects and are grouped into two categories: context and project. Context criteria concern aspects that are clearly beyond the physical boundaries of the site. Either the project has a larger impact than that defined by the brownfield site, or external factors interact with the project. Project criteria concern aspects whose issues lie within the boundaries of the site. These criteria relate to both built and unbuilt areas of the site.

For each criterion, a set of quantitative and qualitative indicators measure a dimension of sustainability. To do so, SIPRIUS attributes four reference values. Limit value (V_L)—minimum value required for any project (or veto value); average value (V_A)—value corresponding to the usual practice, no performance in particular; target value (V_T)—value to target in order to achieve a greater performance; and best practice value (V_B)—value corresponding to particularly high performances. Each indicator has its own datasheet containing all the relevant information to perform the evaluation: description, evaluation method, measurement unit, reference values, and references.

The representation of the results in a histogram allows comparing and following the evolution of the performances according to an urban brownfield regeneration project's progress. For indicators relating to context criteria, the evaluation results show, simultaneously, the current situation (upon evaluation), the initial situation (before the regeneration process), and the expected final situation (predictable value at the end of the project, based on all the elements known at the time of the evaluation). For indicators relating to project criteria, the evaluation reflects the long duration and the realization in many stages characterizing urban brownfield regeneration projects. Indeed, one part of a regeneration project is often already completed while another is at the design phase. In this sense, the evaluation results show the different evolutionary phases of the project: the initial objective, the final expected situation, as well as the current situation (the design, construction, and operating phases). Figure 9.2 shows the histograms for the context and project criteria. In addition to the levels corresponding to the reference values (right axis), the histogram also indicates the conventional regular graduated scale (left axis).

SIPRIUS has proven to be a relevant method to evaluate the sustainability of urban brownfield regeneration projects. Indeed, a successful test application to a case study

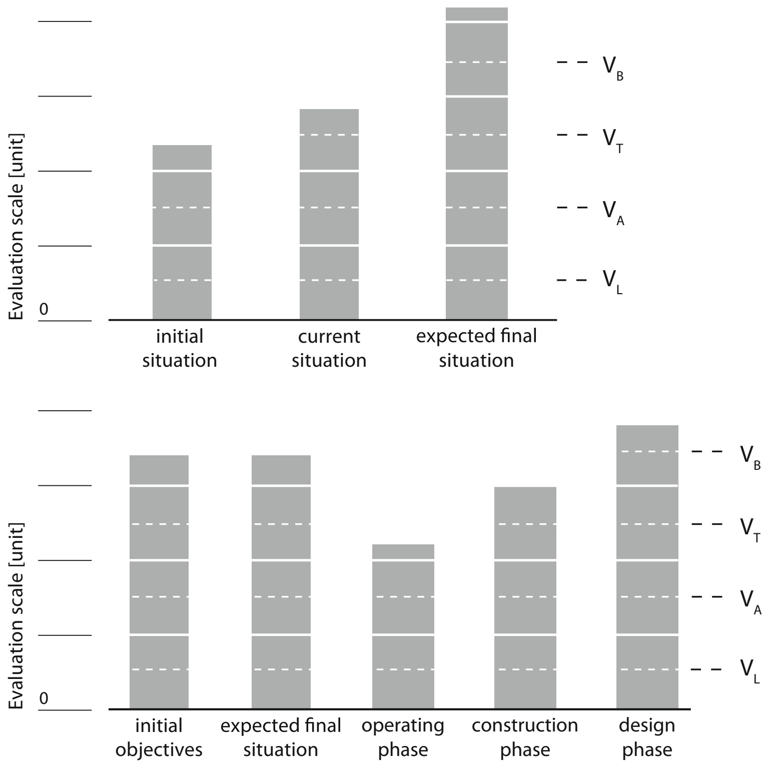

Fig. 9.2 Graphical representation of context (above) and project (below) indicators

was performed (Rey 2012): the Ecoparc Neighbourhood in Neuchâtel, Switzerland, introduced in Chap. 2. However, this earlier version of SIPRIUS is not operational; because it is not integrated into a digital tool, its use on a regular basis depends too much on stakeholders' motivation. Moreover, the indicator system does not address governance aspects. Developed in 2006, SIPRIUS needs adaptations if it is to comply with current practice.

9.2.2 Adaptations

To help meet our three general requirements, the following adaptations of the multi-criteria evaluation system SIPRIUS were necessary: first, the update of the existing indicators and reference values, second, the inclusion of missing criteria and indicators, and third, the creation of a list of governance criteria and indicators.

Our update concerned seven indicators to reflect current concerns and evolving practices, norms, and standards. In these cases, the reference values (V_L, V_A, V_T, and V_B) are more restrictive today than the ones suggested by the original version of SIPRIUS. For example, indicators regarding global warming potential (GWP) and non-renewable primary energy for construction, renovation, and demolition of buildings had no reference values in the first version of SIPRIUS because, at the time, no comparative calculations or targets were available. Since then, the Swiss recommendation SIA 2040 has been released, which encloses objectives for both indicators (SIA 2017).

We added four new indicators after comparing SIPRIUS with other indicator systems specifically developed for brownfield regeneration projects and sustainability certifications at the neighbourhood scale (see Chap. 8). For example, mobility plans for companies and the prevention of light emissions are considerations that we integrated as new indicators.

To meet the fourth pillar of sustainability, governance, we created a new list by analysing the literature as well as other indicator and certification systems. The list contains 11 indicators, which use a determined reference value to evaluate the management and the process of the project. The indicators linked to the management of the project have a concrete dimension such as remediation, temporary use, construction site, and commissioning. They are limited in time to a specific project phase. This does not exclude a regular evaluation, starting from the beginning of the project, in order to set objectives. The indicators linked to the process evaluate the smooth execution of the regeneration project and the proper implementation of the sustainability objectives. Participation, collaboration, information access, and the evaluation process are integrated. As was done with the context and project indicators, the evaluation results for each indicator are presented in a histogram. Figure 9.3 shows the performance for the objective, the current situation, and the expected final situation.

After completing these adaptations, the multi-criteria evaluation system offers 57 indicators. Tables 9.1, 9.2, and 9.3, respectively, list the context, project, and

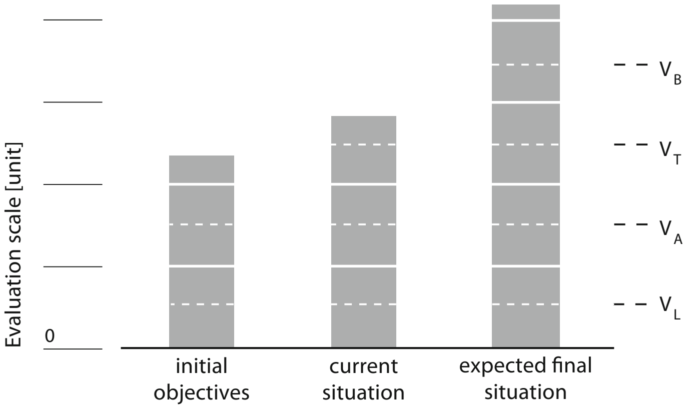

Fig. 9.3 Graphical representation of governance indicators

governance criteria and indicators. Within each list, we identify indicators that have been updated and ones that have been added from the original version of SIPRIUS. The full catalogue of indicators is available in datasheet form in the appendix.

The resulting multi-criteria evaluation system was then adjusted to other national contexts. The challenge was to reflect current and innovative practices from different countries and regions while keeping a certain homogeneity of the indicator system. So far, adjustments have been made to comply with the French and Belgian national contexts. The changes concerned mostly quantitative indicators, and more precisely their reference values. The qualitative indicators remain mostly unchanged, as long as this does not conflict with specific national practices (also available in the appendix).

9.3 The Quality Management Monitoring Software

9.3.1 Description

OKpilot is a web-based collaborative monitoring tool developed as a software-as-a-service (SaaS) based on cloud computing, which ensures the user's smooth implementation, simple maintenance, and lower operating costs. It is accessible online simultaneously via different individual logins (usernames and passwords). It is designed to help private and public organizations comply with different standards (sustainability, quality, social responsibility, health and safety, etc.) using checklists of indicators and increase their performance (GLOBALITE Management 2014). In service to those users, the tool emphasizes clear, simple, and transparent communication of results. The operational monitoring software has features that allow setting, managing, and reaching objectives for optimal control of projects and activities. OKpilot is actually composed of four main inter-related modules: evaluation (based

Table 9.1 Context criteria and indicators. Indicators marked by an asterisk (*) have been updated from the original version. Criteria and indicators marked by a plus sign (+) have been added to the list

Context criteria and indicators			
Environmental impact			
C1	Mobility	C1.1	Quality of service in public transport
		C1.2	Number of parking spaces
		* C1.3	Tying status with "soft" mobility networks
		+ C1.4	Company mobility plan
C2	Air pollution	* C2.1	Average annual emissions of NO2
		* C2.2	Global warming potential (GWP)
		C2.3	Acidification potential (AP)
C3	Noise pollution	C3.1	Average emissions of noise—day
		C3.2	Average emissions of noise—night
+ C4	Light pollution	+ C4.1	Degree of prevention of light emissions
Sociocultural impact			
C5	Proximity of school facilities	C5.1	Average distance to a nursery
		C5.2	Average distance to a kindergarten
		C5.3	Average distance to an elementary school
		C5.4	Average distance to a junior high/middle school
		C5.5	Average distance to a high school
C6	Proximity of commercial facilities	C6.1	Average distance to a commercial zone
C7	Proximity of recreational facilities	C7.1	Average distance to a public park
		C7.2	Average distance to a recreational green/natural area
		C7.3	Average distance to a cultural centre

(continued)

Table 9.1 (continued)

Context criteria and indicators			
		C7.4	Average distance to a sport centre
Economic impact			
C8	Population	C8.1	Net population density
C9	Employment	C9.1	Net employment density
C10	Local economy	C10.1	Proportion of work carried out by local companies

on a checklist of indicators evaluated at different states); outcomes (with diverse possibilities of visualization modes, benchmarking, and reporting exports); management (including management solutions such as the setting of objectives and responsibility assignment, risk alerts, internal messaging, user configuration, etc.); and information database (gathering documents and other evidence on the evaluated object as well as documentation supports for the evaluation like norm or standards).

Although OKpilot is business-oriented—and consequently not used to monitor sustainability in the built environment—its versatility and high level of flexibility are major assets. Thanks to a clear dissociation between its monitoring functionalities and the evaluation database, OKpilot has the potential—with some adaptations—to answer the need for an operational monitoring tool tailored to urban brownfield regeneration projects.

9.3.2 Adaptations

In collaboration with the software's computer service, we made a series of adaptations of OKpilot to make it compatible with the revised version of SIPRIUS. More precisely, we adapted some features of OKpilot to evaluate and display sustainability indicators according to the logic of SIPRIUS. Consequently, our adaptations concerned the evaluation and outcome modules; the management and information database modules were highly functional and already compatible with SIPRIUS.

Most of the adaptations required only minor programming adjustments. For example, this was the case for the harmonization of technical terms used by OKpilot and SIPRIUS, the addition of an extra level of evaluation to make a distinction in the results between sustainability dimensions, or the possibility to unselect irrelevant indicators according to projects (heritage or remediation for instance). Nevertheless, two adaptations required more extensive programming.

The first one asked for a change in the way indicators are measured and had a direct impact on the evaluation module (see Fig. 9.4). OKpilot originally worked with relative values, expressed as a percentage. We made an adaptation allowing the measurement with absolute values, corresponding to SIPRIUS' reference values

Table 9.2 Project criteria and indicators. Indicators marked by an asterisk (*) have been updated from the original version. Criteria and indicators marked by a plus sign (+) have been added to the list

Project criteria and indicators			
Environmental balance			
P1	Land	P1.1	Floor area ratio
P2	Energy	* P2.1	Non-renewable primary energy for construction, renovation, and demolition of buildings
		* P2.2	Non-renewable energy for buildings in operation
P3	Water	P3.1	Infiltration surface and stormwater use
P4	Biodiversity	P4.1	Green surfaces
		+ P4.2	Degree of ecosystem considerations
Sociocultural quality			
P5	Well-being	* P5.1	Annual hours of overheating
		P5.2	Interior noise level
		* P5.3	Spatial daylight autonomy (sDA)
		P5.4	Degree of electrosmog
		P5.5	Degree of individualization of housing
		P5.6	Quality of outdoor spaces
P6	Security	P6.1	Degree of security
P7	Heritage	P7.1	Degree of enhancement of existing heritage
P8	Diversity	P8.1	Degree of functional mix
		P8.2	Potential of social diversity
		P8.3	Degree of universal access
Economic efficiency			
P9	Direct costs	P9.1	Investment costs
		P9.2	Gross rental yield
P10	Indirect costs	P10.1	Annual operating costs
		+ P10.2	Level of occupancy
P11	External costs	P11.1	External costs
P12	Flexibility	P12.1	Degree of building flexibility

Table 9.3 Governance criteria and indicators. Criteria and indicators marked by a plus sign (+) have been added to the list

Governance criteria and indicators			
Management			
+ G1	Remediation	+ G1.1	Logic of project footprint
		+ G1.2	Degree of site remediation
		+ G1.3	Degree of residual contamination
+ G2	Temporary use	+ G2.1	Transitional occupation initiatives
+ G3	Construction site	+ G3.1	Management of construction waste
		+ G3.2	Management of construction disturbances
+ G4	Commissioning	+ G4.1	Commissioning plan for buildings
Process			
+ G5	Participation	+ G5.1	Degree of participation of population
+ G6	Collaboration	+ G6.1	Degree of collaboration of professionals
+ G7	Information access	+ G7.1	Degree of access to information
+ G8	Evaluation	+ G8.1	Degree of integration of an evaluation process

(V_L, V_A, V_T, and V_B). Accordingly, we developed a new slider in the evaluation module, which allows assigning a value to each indicator. A standard colour code was associated with each reference value: orange corresponds to V_L, yellow to V_A, light green to V_T, and dark green to V_B. As for red, it corresponds to an indicator whose performance does not reach the limit value (V_L). Finally, the module improvement also includes all relevant information and references to assist the evaluation for each indicator, thanks to a digital transposition of the datasheet presented in the appendix.

This adaptation required coding work that had repercussions on the presentation of the results in the outcomes module. Thus, we did this work concurrently with the second major adaptation: enhancement of the graphical displays. The "Chart" display, which gives an overview of the results at a given moment, showed in the previous version only aggregated results under each criterion. It has thus evolved to show every indicator simultaneously. Furthermore, we developed options allowing for customized visualization according to a selection of indicators, a sustainability dimension, or a value obtained (Fig. 9.5). The resulting graphical display called "Evolution" is a completely new monitoring feature of OKpilot. It shows the evolution of a given indicator from the objective or initial situation to the expected final situation, including the various situations (Fig. 9.6). It has the same options as the "Chart"

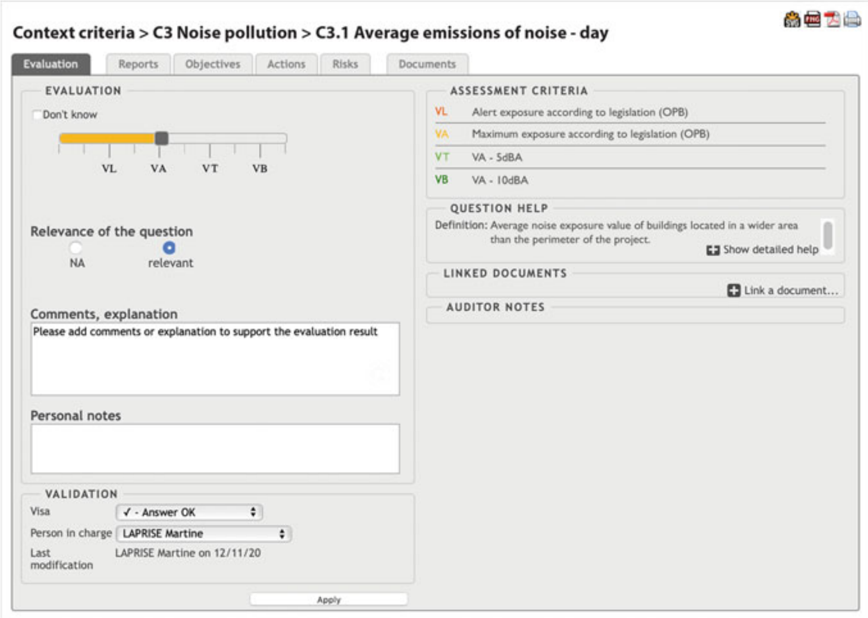

Fig. 9.4 Evaluation module for a given indicator

display, plus the option to show a summary of the repartition of several indicators (context, project, or governance), according to their performance (Fig. 9.7).

9.4 An Operational Monitoring Tool to Support Neighbourhood in Transitions

Following these adaptations, we consolidated the hybridization between the indicator system SIPRIUS and the monitoring software OKpilot, allowing the creation of the operational monitoring tool SIPRIUS+. Figure 9.8 is a schematic representation of the tool's structure. More precisely, SIPRIUS provides the content of SIPRIUS+, while OKpilot supports it and makes it operational. It means that the three summary lists of criteria and indicators (context, project, and governance and the attached datasheet) were coded and imported into OKpilot. From there, they became checklists used to monitor, in this case, urban brownfield regeneration projects located in Switzerland. The operation was then repeated for the French and Belgian lists. In total, nine checklists are available within SIPRIUS+.

Figure 9.9 introduces the homepage of SIPRIUS+, which welcomes users with a simplified menu designed to make the tool more user-friendly. It can be customized to the project that is monitored. To start using the tool, users must create a "site", that is to say, an urban brownfield regeneration project in a specific country. Then, they

Fig. 9.5 Chart display showing the expected final situation of context indicators

must select a checklist (context, project, or governance) and a state (initial situation or objective, current situation, and expected final situation). Users can always access these selection buttons in the top toolbar. After these preliminary steps, they can start monitoring their neighbourhood in transition.

Essentially, the result of this hybridization process is a tailor-made operational monitoring tool that specifically supports the regeneration of urban brownfields into sustainable neighbourhoods. In that sense, it is designed to meet the three general requirements set at the beginning: a search for overall quality, adequacy with the specificities of urban brownfield regeneration projects, and integration into the project dynamics.

In order to validate this result, SIPRIUS+ went through a complementary two-step verification process (Laprise et al. 2018). The first step consisted in the test application on three case studies: Val Benoit neighbourhood in Liège (Belgium), Gare-Lac neighbourhood in Yverdon-les-Bains (Switzerland), and Pôle Viotte neighbourhood Besançon (France). The aim was to validate the functioning and robustness of the monitoring tool. The second step consisted of interactions with the stakeholders involved in each case study. The aim was to challenge the tool and gather points

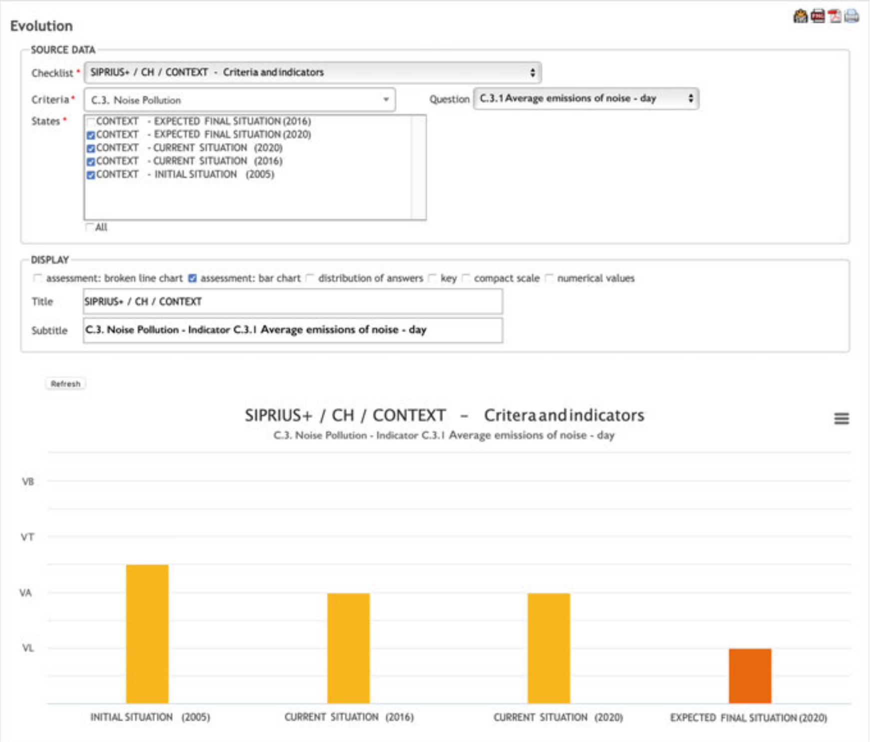

Fig. 9.6 Evolution display showing the performance of given indicators

of view of future end-users on the reality of the practice. The process has shown that the inclusion of a monitoring practice is not only feasible but also realistic and desired. It revealed that SIPRIUS+ has the potential, not only to facilitate a structured and regular follow-up of sustainability objectives integrated into project dynamics but also to provide outputs easy to interpret by different professionals involved in the project and simple to communicate to a wider audience. Hence, SIPRIUS+ is expected to contribute to decision-making in a multi-disciplinary manner, without giving ready-made solutions, but allowing iterative project settings. Concretization of the sustainability vision and maintaining the objectives will always depend on the motivation and involvement of the stakeholders (Laprise and Rey 2019). The next chapter illustrates a real-world application on an ongoing urban brownfield regeneration project.

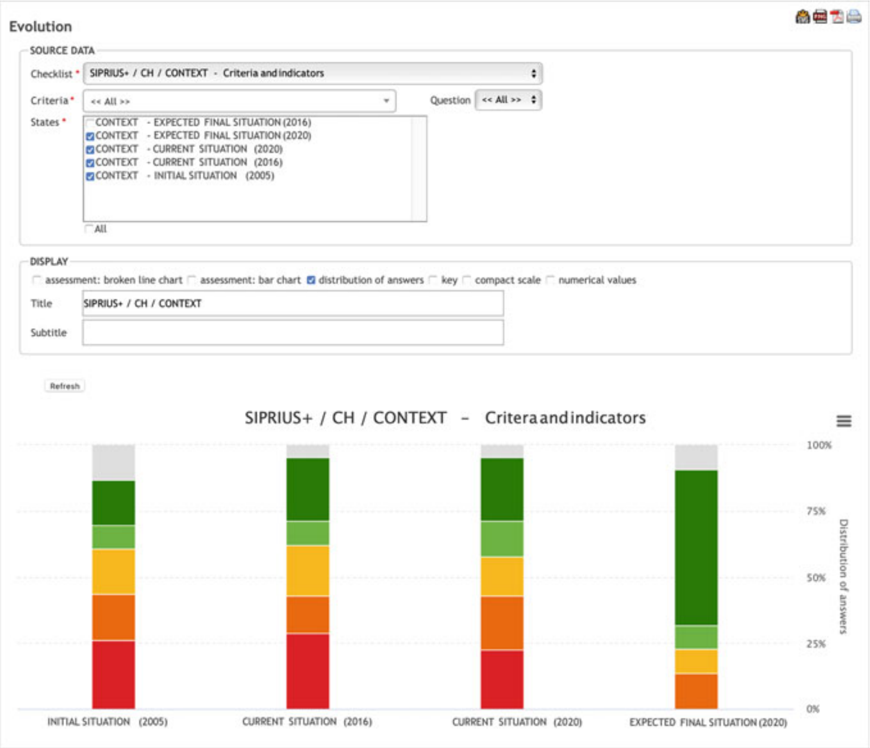

Fig. 9.7 Evolution display showing all indicators' performances

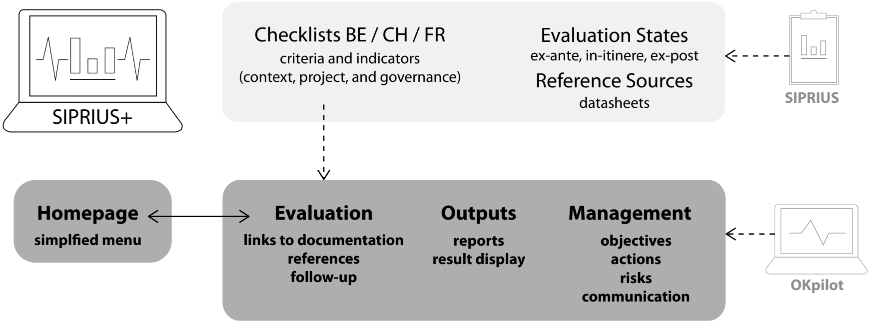

Fig. 9.8 Schematic representation of the structure of SIPRIUS+ hybridizing an indicator system (SIPRIUS) and a monitoring software (OKpilot)

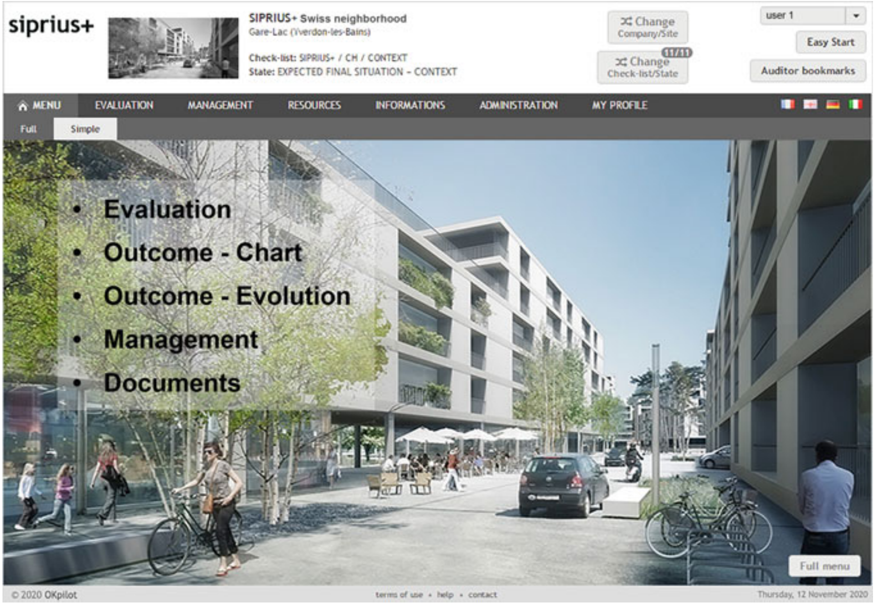

Fig. 9.9 SIPRIUS+ Homepage

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