

EAR methodology: an approach to Sustainable Urban Water Management

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In the last few decades, urban drainage systems have become much more than a simple removal of storm-water and sewage out of the city. Urban water management must adapt to the city and its evolutions; the driving forces are numerous with a diverse range of origins: social evolution (increasing expectations regarding levels of service), societal evolution (increasing complexity of regulations and institutions, which make urban water management more complex), environmental evolution (climate change and its consequences, etc.), technologic evolution (including new monitoring possibilities), economic evolution (global markets, share of costs between stakeholders). Importantly, urbanization has had significant impacts on urban water cycle (Chocat *et al.*, 2007). Pressure exerted on cities and, in our context, on urban water system has led to the need to consider more functions, thus making it necessary to modify (expand) the boundaries of the system. Urban water system must include drainage system, the catchment and the city itself, in order to establish a balance between each of the three sub-systems. This will enable functions such as ecosystem protection, water resource scarcity, adaptability, re-use of storm and waste waters to be promoted. Studies identifying these functions is well documented (Ashley *et al.*, 2002 ; Ashley *et al.*, 2007 ; Chocat *et al.*, 2007 ; Fletcher *et al.*, 2009 ; Novotny et Brown, 2007 ; Wong *et al.*, 2008).

This sustainable water management presents a worldwide challenge for the 21st century. In the scope of this challenge, it is necessary to replace traditional management approaches by a new concept, often referred to as sustainable urban water management (SUWM) (Brown *et al.*, 2006; De Graaf, 2009; Hellström *et al.*, 2000; Kaufmann, 2007; Larsen, 1997; Mitchell, 2009). One key aspect of this approach is the necessity that storm water and wastewater should become again considered as a resource (as they were a few centuries ago) and not as a nuisance or a risk (Chocat *et al.*, 2007).

This new paradigm introduces the necessity to evaluate new methodological approaches and new tools and technologies. In terms of methodological approaches, recent research has focused on three main directions: performance indicators (Matos *et al.*, 2003), guidelines (Boogaard *et al.*, 2008; Hall and Lobrina, 2009; Lems *et al.*, 2006) and decision-support tools dedicated to a part or the whole system (Förster *et al.*, 2003; Taylor *et al.*, 2006; Le Gauffre *et al.*, 2007 ; Moura, 2008; Saegrov, 2006). However, sustainable urban water management must also consider means of interactions and cooperation between all stakeholders and institutions, at the catchment-scale and at the city-scale. Methods must thus address both technical facilities (devices, treatment systems, etc) and the organisations (local authorities, private enterprise, community group, etc.) which play a role in urban water management.

The objective of our project (Granger, 2009; Cherqui *et al.*, 2009) is to develop and test a multi-disciplinary assessment management methodology, which gives (i) urban water manager the ability to measure the provided service by urban water system; and gives (ii) stakeholders the ability to choose a strategy that matches their expectation of the service provided. An implicit objective of this project is to initiate a cooperative relationship between service provider, local government and others stakeholders. This close collaboration has been initiated thanks to this project.

Our project considers technical, environmental, social, economical and organizational aspects. It enables the assessment of the efficiency of a strategy before and after implementation, in order to provide an understandable decision support system (facilitating public discussion

regarding the definition of assessment criteria, production of scientific data, and rationalization of decisions within the deliberation processes).

More precisely, this methodology enables urban water managers :

- defining precisely traditional and emerging functions that a sustainable urban water system should fulfil;
- communicating and interacting with all stakeholders¹
- defining the level of service that is expected by stakeholders and organizations regarding each function (target levels for each indicator);
- defining the stakeholders, organisations and devices that are involved in producing the service and providing the expected of service level;
- choosing a strategy that is expected to be the most efficient way to fulfil the targeted performance;
- assessing the service level that is actually provided by the system, throughout its implementation;
- producing feedback on the strategy, by taking account of the demand evolution and/or gaps observed between expected performance and actual performance of the strategy.

The methodology developed is entitled EAR and includes an iterative five-steps procedure (Figure 1): “Evaluation – decisions – Actions – survey – Retroaction”. The method derives from the PDCA (Plan-Do-Check-Act) wheel.

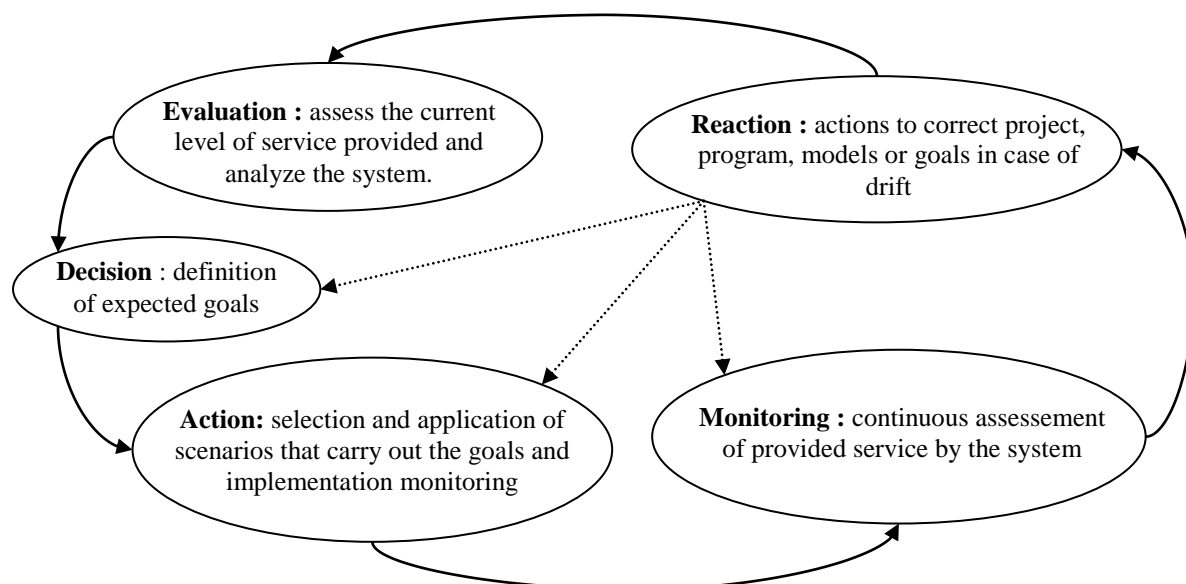


Fig. 1 General model functioning of the EAR methodology

Urban water management system is assessed using indicators which are locally pertinent and understood by all local stakeholders. Relations between these easily-understood indicators and possible actions on the system (ie. cause-effect relations) are not exact, but are instead empiric relations based on local expertise (e.g. aquatic ecologists, hydraulic experts, etc).

The first step (Evaluation) of the methodology is applied on the SIVOM (Intermunicipal Union) of the Mulhousian area (Alsace, France) where a close collaboration exists between the SIVOM, the “Lyonnaise Des Eaux” (the mulhousian water system manager) and local stakeholders. This trial application confirmed that the most important elements of the

¹ Easily-understood indicators are means to assess provided service and to know needs and expectations of all the stakeholders. These indicators can be provided by surveys, interviews and/or meetings with stakeholders.

methodology are the (i) definition of the cause-effect relations (ii) construction of the proposed actions and the (iii) retroaction phase. Whilst relations established between cause and effects by local experts represent the best available knowledge, they must be updated as new information is gathered. By continuously monitoring service quality, it is possible to correct or adapt these relations. Fig. 2 presents an example of the relation between bathing (swimming, water recreation) use indicator (of a specific territory of the case study) and appropriate means of action for improving the quality of waters for this purpose.

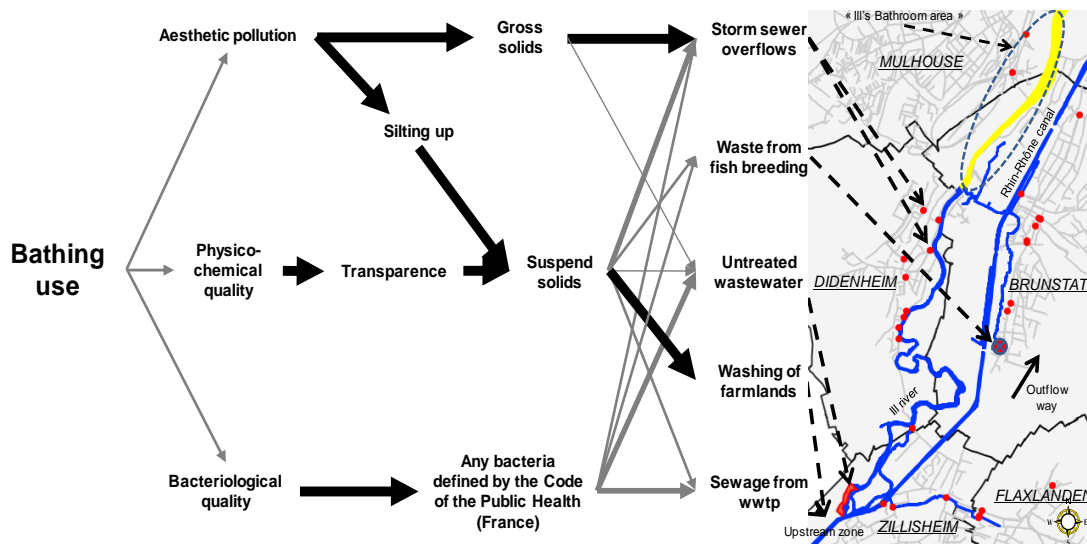


Fig. 2 Cause-effect relations for bathing use on the "Ill's Bathing area" on the SIVOM on the Mulhousian region, Alsace, France (Granger et al., 2008).

The methodology is readily reproducible for other locations: local specificities will lead to choose other pertinent local indicators and different cause-effect relations than for Mulhouse. One remarkable difficulty in the realisation of the methodology, and more exactly in the realisation of cause-effect relations, is that only few stakeholders have a global view (holistic) of the whole system and it is necessary to contact a large number of experts with different views and complementary expertise and to combine these partials and sometimes contradictory expertise. However the EAR methodology enables to formulate all points of view at a same level, even competing interests.

The definition of easily-understood indicators allows the assessment of provided service based on results objectives. It is then possible to define goals in terms of results and not means; however our limited experience has shown that local government is not often willing to communicate about future means instead of future results. This methodology, as numerous works, must assure local government what future results can be achievable.

Furthermore, this methodology can be adapted to other domains (e.g. management of public land, transport facilities, waste management, etc), where decision making is required and where the system to manage is complex to understand and represent.

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