Stormwater in existing urban areas

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Introduction

This article focuses on experiences with stormwater issues in the Netherlands. Since mid 80's a lot has been changed. Until mid 80's urban water management was more or less equivalent to sewer management, where 70% of the systems is combined, and stormwater was regarded as 'waste' that has to be discharged to canals, rivers and sea as quickly as possible. Nowadays, stormwater is a resource - also according the new Dutch Water Law - and stormwater, sewers, surface water quantity, surface water quality, groundwater, ecology and urban design are approached in an integrated way, especially in new residential areas. In every new plan integrated urban water management is fully implemented and many urban areas have "a sustainable water system". However, in existing urban areas it is still difficult. There are many successful examples of disconnecting impervious from sewers and stormwater infiltration, but to conclude: most of the projects seem to be too expensive. Implementing sustainable water solutions in existing urban areas is costly (low participation, function integration, hard to implement innovation ….). Without a change in approach pilot projects will not evolve into large scale change. This article advocates an important principle: for being successful in existing you need both technical and social innovation.

Figure 1. Intensive stormwater events in August 2006, led to flooding in the main shopping street in Egmond aan Zee.

Case Egmond aan Zee

The popular beach resort for many Germans and other tourists ‘Egmond aan Zee’ in the northern west part of the Netherlands experienced two extreme stormwater events in the month August 2006. The stormwater events had an intensity of 60 mm/hour that statistically would occur once in 50-100 years, leading to floodings in the area. The stormwater flowed from the higher parts onto the lower centre. Shops were flooded (see Figure 1), which resulted in huge damage to property and a lot of discontent.

Both citizens and the politicians asked for solutions. Flooding problems should be avoided in the future. This means that sustainable urban drainage systems had to be implemented in a densely built existing urban area. Building activities will have impact on the day to day life in the town. Therefore a lot of stakeholders had to be involved.

Figure 2. Construction of an infiltration basin in the heart of Egmond aan Zee.

Technical innovation

In order to make this area flood resilient, and to meet the Dutch water quality standards, the following criteria have been used to select the most sustainable urban drainage systems: flood reduction, pollutants removal efficiency, costs (construction and maintenance), required space, sustainability, aesthetics, robustness and life cycle analyses. The next technical solutions were chosen (Top 5):

1. Swales ("Mulden Rigolen Systemen");
2. Infiltration trenches;
3. Pervious pavements;
4. Water barriers to guide water;
5. Infiltration basins.

The last category 'infiltration basins' had the largest impact on the citizens' daily life. On three locations basins of approximately 4000 m^3 had to be build close to houses (see Figure 2) with a building time of one to two years. Several meetings and tools (flood mapping, serious gaming) were used to explain the need for these measures. Now almost 90% of all measures have been implemented and Egmond is considered to be flood resilient.

In principle, the applied techniques are well-known and not innovative in itself. However, composing the right combination of measures and put them into practice in a densely built area, seems *really* complex. It is impossible to make a plan with full support from all stakeholders at once. The whole process has to be organised in an adaptive way, as a learning process.

Complexity and uncertainty

By introducing a new technological regime into the existing urban area, we meet complexity. This complexity is partly related to social aspects, so besides technical innovation we also need social innovation. The heart of this social innovation needed is, that complexity should not be regarded as a nuisance, something that has to be suppressed, but as a fact of life. Life is complex by nature and by suppressing it we also suppress life characteristics. Complexity is a pre-condition for change. For many people this statement is contra intuitive. So it is not easy to apply it in practice, especially due to the fact that complex processes show many uncertainties. Coping with uncertainty is probably the most essential thread running through all Dutch water projects in existing urban areas.
There are many technical uncertainties, especially concerning hydrological and chemical aspects. What is the urban run-off? How often can we expect an urban flood? Will the subsoil be contaminated? What will be the increase in rain volume due to climate change? Is it possible to utilise stormwater for cooling down cities during hot summers? Will maintenance be a problem? Do we still need energy from the urban water cycle after twenty years? Finding the best combination of measures in the existing urban context is already hard. But our experience is that the uncertainties related to economic and social aspects are the most tough. What will be the developments in the economy in the next coming years? Will there be enough political and public support? How will this support develop itself?

In complex processes, it is best to set out a course between too much and too little uncertainty. If no uncertainties are accepted, nothing will change. It is an attitude of rather doing something wrong and being certain about it than doing something that might actually be right. On the other hand, it is also important that there are not too many uncertainties at play because processes will then predictably go wrong. This middle path is not calculated, but it emerges by making plans with both many and few uncertainties. Iteratively, structural adaptations are determined. On the middle path, the parties involved feel that uncertainties are manageable and that there are enough opportunities to reduce uncertainties through further investigation. It stipulates the learning dimension.

Tacit Knowledge and learning

In 2006 a research programme started in the Netherlands on the relationship between knowledge, learning and complexity [1]. This research especially focussed on the importance of Tacit Knowledge: implicit knowledge that people acquire when they get experienced. It was introduced by the philosopher Polanyi [2]. Tacit knowledge is person-specific, difficult to reproduce or quantify, with no specific focus but available for a range of (unexpected) situations. At the beginning of the research three propositions were postulated: (1) the complexity of water management increases, (2) for coping with such complexity Tacit Knowledge is crucial and (3) attention given to Tacit Knowledge in water management decreases; therefore Tacit Knowledge becomes marginalised. The research results confirm these propositions and introduces a direction for improvement: New Craftsmanship.
It is interesting to see that in the time of the Medieval Guilds craftsmen applied two main principles for learning [3]:

1. Acting repetitively;
2. Story telling.

By doing procedures over and over again, people learn, and by telling stories they exchange knowledge, both implicit (Tacit) and explicit. For several hundreds of years this way of learning was

very successful. Only the last decades there has been a shift to modern ways of learning, with modelling, measurement programmes, studies, meetings, etc. The data from the research on Tacit Knowledge [1] illustrates that nowadays some experts attend meetings for more than 50% of their working time.

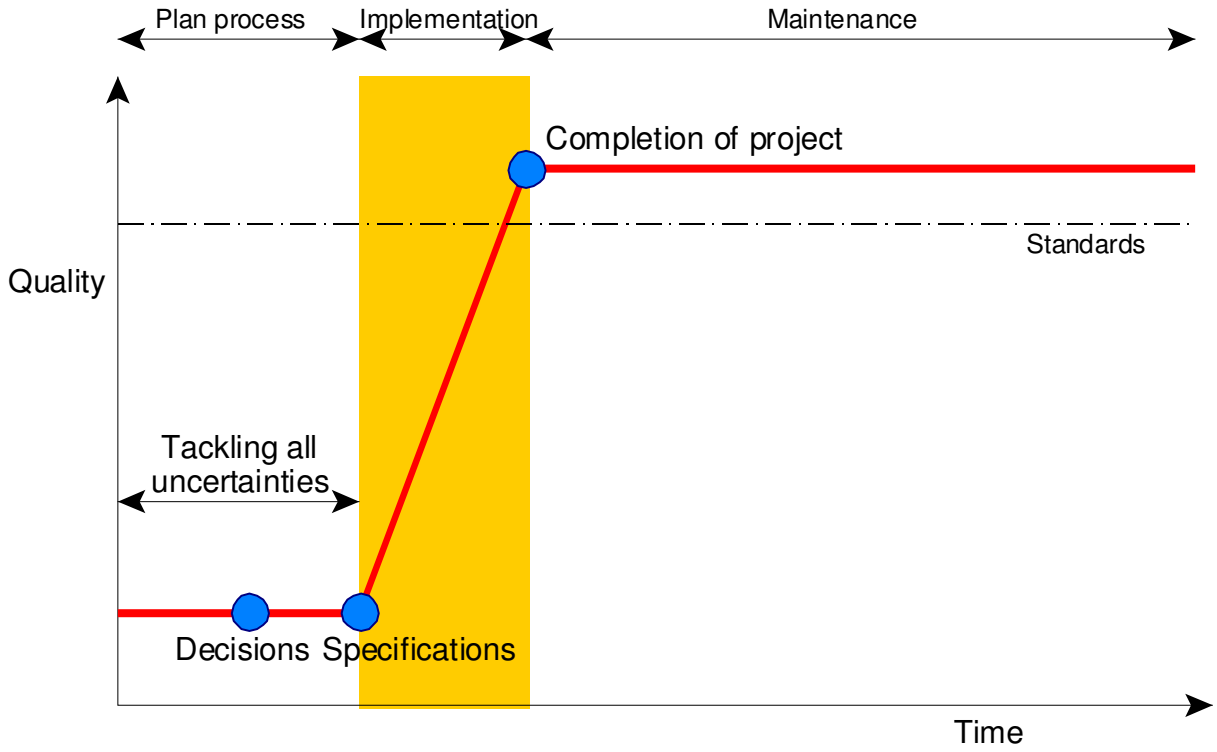

Figure 3. Some characteristics of a traditional process.

The KWW Strategy

Based on all experiences until now, the awareness of increasing complexity and uncertainty and the importance of Tacit Knowledge, the KWW Strategy emerged. KWW stands for "Kiek'n wat ut wordt" which is Dutch dialect for "look what will happen." In some low German dialects it is nearly the same. Figure 6 shows a schematic representation of a traditional approach for a stormwater project. There are three phases: (1) plan process, (2) implementation and (3) maintenance. In these phases different people are active. In the plan process planners, engineers, decision makers and many others make a plan or a design. In principle, they tackle all uncertainties in this phase. When the plan is ready and the specifications have been developed, the work will go to a contractor. After completion, the projects is finished, the standards are met and the objects constructed (assets) will be handed over to the people that maintain.

This traditional approach suffices when complexity is relatively low and uncertainties can be handled in a relatively simple way. However, when complexity increases and it is impossible to tackle all uncertainties in the phase of the planning process, a KWW Strategy is preferred.

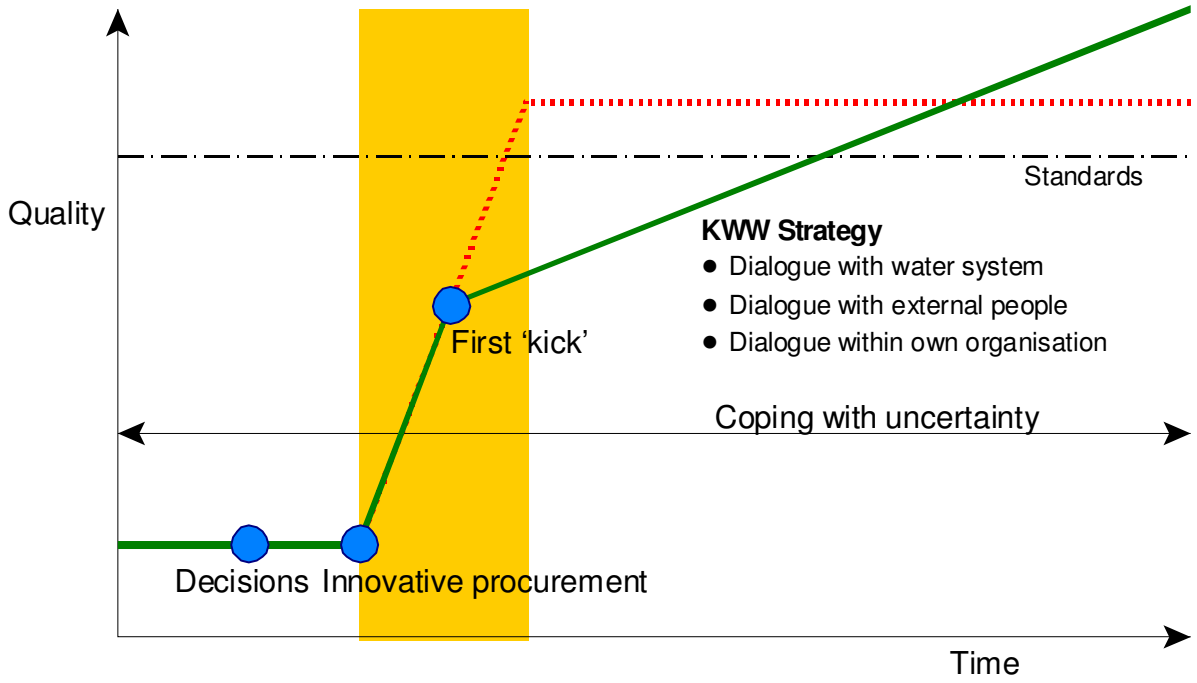

Figure 4. Some characteristics of a KWW Strategy.

The KWW Strategy reflects a process of learning by doing. It offers a modern version of how Medieval Guilds organised the learning process. The main difference with the traditional approach is that it is harder to distinguish the three phases. In fact, the maintenance people are involved in the process from the beginning and not all measures are taken at once. Traditionally the governmental organisations will pay for all construction works, but in the KWW Strategy the implementation is restricted to a first 'kick', where costs are shared by several actors, both private and public. After the first kick the process continues and for the water experts there is an ongoing dialogue with the water system, the external people (e.g. the citizens and companies) and the people within the own organisation. In this dialogues the middle path evolves. Essential in the KWW Strategy is that besides an exchange of explicit knowledge - reports, emails, model results, measurements, etc. - there is a constant flow of Tacit Knowledge. People share experiences by telling stories.

Table 1. Two approaches for coping with stormwater projects

Traditional Approach	**KWW Strategy**
Meetings, workshops, studies, etc.	Werkplaatsen (Workshops)
Integrated, complete and complicated	Small, local and concrete
Communication *about* a project	Communication *within* a project
Discussions, negotiations	Narrative approach (story telling), building up a common story
Main focus on Logos	Main focus on Ethos

Table 1 shows some other characteristics of the KWW Strategy. These will not all be discussed in this paper. Quite essential is the last row. Aristotle stated that we have to search for *phronesis*, which stands for practical wisdom. He showed that for phronesis there a three building blocks: Logos, Ethos and Pathos. Roughly, Logos is about logic and rationality, Ethos about position and attitude and Pathos about feelings, empathy. Nowadays, the main focus in stormwater projects is on Logos.

Models are used to calculate the optimal solution. In the KWW Strategy Logos is still important, but extra attention is given to Ethos and Pathos. The research on Tacit Knowledge [1] shows that in many complex water projects especially Ethos is the Achilles heel. The KWW Strategy results in a significant social innovation, for coping with both technical and social uncertainties.

Conclusions

Adapting stormwater systems in the existing urban areas is more complex than in new built residential areas. The case Egmond shows that well-known applied techniques, that compose the right combination of measures and put them into practice in a densely built area, is *really* complex. It seems impossible to make a plan with full support from all stakeholders at once. The whole process has to be organised in an adaptive way, as a learning process.
It is possible to introduce sustainable water measures, but within the present paradigm of (1) implementing the optimal plan at once and (2) financing projects by governmental organisations, it is too expensive. A significant social innovation is needed to cope with the complexity and the related uncertainties, both technical and social. The KWW Strategy offers good possibilities.

References

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