

## Self-Monitoring as Part of the National Reporting Commitments Specialised Software from Descriptive Models

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### Abstract

Hessian sewage plants (*Hessische Abwasseranlagen* HAA) supports the processes around the monitoring and administration of sewage plants in the communal area. Besides the monitoring of approx. 2.000 sewage plants/sewers in the future also 5.000 private/small sewage plants will be liable to report within the scope of the Hessian "Eigenkontrollverordnung" (EKVO, self inspection). At present a new highly flexible data entry and transmission software is realised for that purpose. This software platform can also be used as a pattern for other environmental domains to provide data entry and transmission to the responsible authorities like federal states, countries or the EU. It is designed to fulfil self-monitoring and reporting obligations of each Member State as demanded by the EU, according to the "General Principles of Monitoring" and E-Government standards.

### 1. Monitoring of sewage plants as part of the water protection

Hessian sewage plants (*Hessische Abwasseranlagen* HAA) is a specialised application which supports the processes around the monitoring and administration of sewage plants in the communal area. HAA is used by the Hessian Ministry of Environment, Rural Development and Consumer Protection<sup>4</sup>, by the Hessian Agency for Environment and Geology<sup>5</sup>, the regional boards and the local water authorities.

The software allows comfortable support of all kinds of processes in the public administration of communal sewage plants and sewer networks. The lifecycle starts with reviewing the construction plans and, under the condition of approval, issuing the appropriate authorizations. The construction plans are stored as schematic diagrams where all relevant data is available per double click on each component. All necessary documents for each task are generated and immediately opened in Word during the workflow. Documents can be reproduced at any time. In addition to the initial construction, modifications of the facilities architecture are a major subject in HAA and the development of sewage plants is archived.

Combined with the construction permit, the approval for discharging the purified water into the river is one of the most important regulations for water protection. Different kinds of approvals are possible, e.g. 'over-all', 'specific' and 'modification' with the possibility for time-limitation. These different types of approvals can overlap each other during specific phases.

Governmental monitoring and state control of water pollution is 'end of pipe' water protection, but none the less the most efficient way to verify that the operating companies comply with the approvals. The different kinds of approvals have to be considered in the compliance test because of the overlapping limit

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<sup>4</sup> <http://www.hmulv.hessen.de>

<sup>5</sup> <http://www.hlug.de>

values. The preparation for inspections consists of the storyboard, e.g. the preparation for different kinds of sampling, and an overview document of the visited sewage plant.

The visit is followed by the lifecycle administration of water samples, their examination in external laboratories, the electronic data import and verification of measured values and the calculation of laboratory costs and fees for the governmental inspection, which is partially based on the analysed water samples. All letters and invoices for the charged fees are again available in Word.

Another feature is the calculation of the inspection frequencies based on the pollution risk-level for the river, the actual and previous degree of compliance with limit values and other characteristic parameters. Since a governmental inspection is not free of charge, there is a motivating aspect to reduce river pollution, too. The time of the next inspections has to be scheduled. Several reminder lists for the user are provided by the application.

Besides the governmental inspection the operators have to perform and report measurements to comply with the self-monitoring regulation. Again reminder lists and letters are necessary to recognise missing or inadequate reports. The precise kinds and locations of sampling have to be announced and stored and the accomplishment needs to be surveyed. In addition, self-monitoring includes the reporting of all assets, including type, size and length of sewer networks, their actual state, all damages, restoration plans and costs. Vice versa the sewage plants have to report different parameters.

The first making of the damage reports was quite expensive for some operators, especially with the underground sewer networks, but in individual cases some alarming damages were uncovered. Nowadays the data is the basis for several general and individual status reports. Other situation reviews usually cover the degree of connection of waste water producer, type and quality of treatment processes, compliance with limit values, e.g. nitrogen and total phosphor, types of waste material disposal and screening of the sewage to river water ratios. These data evaluations are provided to individuals according to the Environmental Information Act, to local authorities, the Hessian parliament, statistic agencies, the Federal Environment Agency, the Federal State and the EU.

The application HAA is provided within the public authority by Microsoft's windows terminal server. For approximately 2.000 sewage plant and sewer network operators a standalone client software was provided for self-monitoring, however, solely on Microsoft operating systems. The client software did not include special knowledge about individual plants or networks; in the import-process the synchronisation with the keys of the HAA application data was therefore text-based and not always accurate. Hand-written reports are also to be accepted which increases the number of errors or the work detecting them.

## **2. Benefits and problems of self-monitoring and self declaration in eGovernment**

Although self-monitoring poses the risk and prejudice of opening the floodgates for manipulations by the operators, existing experience shows a number of important benefits: self-monitoring provides improved or additional status overviews for the operators, cost reductions rapid response to damages given and even protection against legal penalties or fines under civil law with the proof of proper work, e.g. for not exceeding the limits. And last but not least it increases environmental awareness of the operators and minimizes water pollution.

In terms of legal regulation, the EKVO is based on the European council directive of May 21, 1991 concerning urban waste water treatment (91/271/EEG)<sup>6</sup>. This directive has been transposed into national law through the Federal Water Act<sup>7</sup> (*Wasserhaushaltsgesetz* WHG, e.g. § 18b Building and Operating Waste Water Installations), the Hessian Water Act<sup>8</sup> (HWG, e.g. § 46 Operation, Self-Monitoring and

<sup>6</sup> <http://ec.europa.eu/environment/water/water-urbanwaste/directiv.html>

<sup>7</sup> <http://www.bmu.de/english/documents/doc/3288.php>

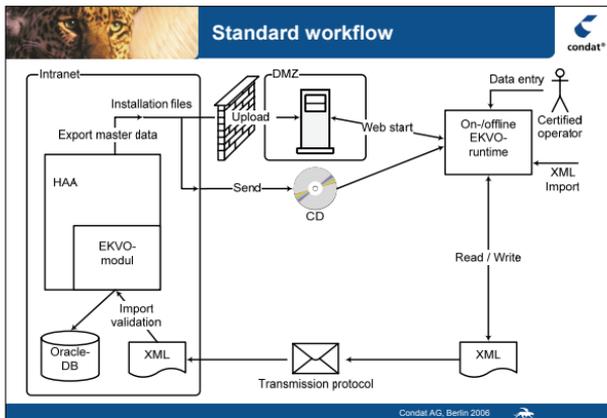
<sup>8</sup> <http://www.hessenrecht.hessen.de/>

Surveillance of Waste Water Installations), the Ordinance on Hessian Sewage Plant Self-monitoring (*Eigenkontrollverordnung EKVO*)<sup>9</sup> inclusive of an insertion in the first amendment of the Ordinance on requirements for the discharge of waste water into waters (AbwVO) and other regulations, e.g. the new formulation of DIN 4261 Part 1 and EN 12566.<sup>10</sup>

Due to legal amendments 5.000 new private and small sewage plants will be liable to report within the scope of the Hessian self-monitoring (EKVO) in the future. Using the governmental requirement to reengineer the EKVO-components as stimulation for additional improvements, a highly flexible data entry and transmission software has been developed under the following two principal objectives:

- Maximise the electronic transmission rate of EKVO-reports to reduce costs by error-prone data entry
- Maximise data quality and reduce the amount of work spent on verification and problem communication

Looking at these objectives an analogy to the German electronic tax declaration system called ELSTER<sup>11</sup> becomes apparent. The process of data collection with client software is similar and the main objectives are much the same. ELSTER is used by German financial departments to receive paperless tax declarations. The free of charge provided tax declaration software ElsterFormular serves the promotion of the electronic procedure.<sup>12</sup> The requirements for ELSTER were not analysed for this paper, but this additional example provides an analog scenario for clarification and to give an idea of our intention.



<sup>9</sup> EKVO from January 21, 2000 (GVBl. I page 59), last change on November 11, 2003 (GVBl. I page 301)

<sup>10</sup> For a more in depth introduction about the legal background refer to <http://www.bmu.de/files/wastewater.pdf>.

<sup>11</sup> Elektronische Steuererklärung, <https://www.elster.de/>, probably also named after a thievish bird, Elster means magpie.

<sup>12</sup> Loose translation from a response of the German government concerning the experiences with the electronic tax declaration: Kleine Anfrage „Erfahrungen mit der elektronischen Steuererklärung“, Drucksache 15/5162, 19.04.2005, Bundesanzeiger Verlagsgesellschaft mbH, ISSN 0722-8333, p. 1, referenced from <http://dip.bundestag.de/btd/15/053/1505307.pdf>

To meet the acceptance of high adoption among end users, i.e. the sewage plant operators, the EKVO-software has to comply with the following requirements:

- Unknown client equipment (hardware / operating system)
- User-friendly operability for a large number of end users
- Specialized support for the different operators: big/small sewage plants, sewer networks
- Fault-tolerant input assistance and input validation
- Integration with local office- and operation journal applications
- Flexible report combined with search and data analysis options
- Secured data transfer according to data protection law
- Availability test and notification of software updates or new master data
- The possibility to report new address data to the government
- No guaranteed internet connection (offline capability)
- And the additional requirements for the EKVO-software to run within the governmental departments:
- Flexible plausibility checks for the data import by the authority
- Complete workflow support from the first request over follow-up letters to annual summary reports
- Integration with the geographic information system (GIS)
- At least five different user groups with different requirements for the functional range
- Preparation for regular modifications of the parameters to be documented due to changing laws

### 3. Technical approach of the new EKVO

The development and production expenses of the electronic tax declaration ELSTER currently add up to approximately 10 million Euro per annum. The amount of development costs for ELSTER was approx. 2.75 million Euro in 2002, approx. 3.3 million Euro in 2003 and approx. 3.6 million Euro in 2004.<sup>13</sup> According to our calculation the development of the EKVO-software will be much lower. Emerging open source technologies provide a lot of functionality which we plan to use. However, the following questions had to be answered for risk assessment:

- Do using high-end state-of-the-art technology and being an early adopter pay off?
- How many technology-experts are needed to produce maintainable EKVO-software?
- How much performance increase can be reached by applying model driven development (MDD)?
- Last but not least: Does the EKVO-software architecture provide a basis for the migration of all HAA and achieve conformity with the Hessian E-Government master plan<sup>14</sup> at the same time?

#### 3.1 The Platform

From the technology viewpoint the Eclipse Rich Client Platform<sup>15</sup> looked promising, which had to be further evaluated. Not all state-of-the-art software necessarily leads to be an early adopter. The Eclipse

<sup>13</sup> ibidem, p. 2

<sup>14</sup> <http://www.hessen-egovernment.de/mm/Masterplan.pdf>

<sup>15</sup> Eclipse Rich Client Platform <http://www.eclipse.org/rcp/>

integrated development environment (IDE)<sup>16</sup> is available as a stable version, but version 3.2 RC5 is from May 19, 2006. The promising reporting tool Eclipse BIRT<sup>17</sup> version 2.1 RC3a and the work saving Visual Editor<sup>18</sup> do require the latest Eclipse version. And the new Eclipse 3.2 JFace data binding<sup>19</sup> already saves days of work but is not even public yet.

A consequence of the use of emerging technologies is that for each one of these technologies an alternative stable technology has to be hold in the backhand. Intensive evaluation and prototyping is the key to reduce the risk of having to replace the promising one. Counting only on the core features is the rule to survive, e.g. half of the promised ones.

Another consequence is the absolute need for a central configuration management. Since an active development community is a requirement for the technology selection process on the one hand, it requires on the other hand continuous adoption of new milestone or release candidates when the workaround on a now fixed bug should be abandoned or a relevant new feature has been introduced. The evaluation of latest releases is not affordable without analytic experts who need a good amount of experience to be quick and accurate enough. It's like a craftsman evaluating whether the work with new tools is more efficient. A Wiki<sup>20</sup> is a good choice to document the continuous work on technology decisions.

The test and deployment of the IDE for the developers has to be automated, versioned and fast. Under this pressure, configuration managers swear by applications that can be installed just by copying files, e.g. without need of installation routines or registry keys. At the utmost one base path needs to be configured per developer. The necessity for a version control system like Subversion<sup>21</sup>, a build manager like Maven<sup>22</sup> and excessive automated testing is unquestioned.

The advantage for the customer is that the development team accompanies the continuous update process from the beginning instead of ignoring it. The drawback of new technologies is their limited guarantee for market success. The customer can rely on the know-how and assessment of the project management or has to evaluate on his own. The greatest advantage of a good decision process is the development speed and a publicly supported open source tool chain providing enormous productivity and long term adaptability.

Besides being efficient the conformity and adoption of standards is required to develop applications intended to be interoperable, e.g. in future service oriented architectures (SOA).

### 3.2 Usability and standards

The 'E-Government Manual'<sup>23</sup> states the vision to accelerate and rationalize workflows, while providing more service and decision transparency. The included document 'Standards and Architectures for E-Government Applications' (SAGA)<sup>24</sup> refines this vision into interoperability and other technical targets.

SAGA defines the web browsers as standard-client and is criticized for restricting the market with this decision<sup>25</sup> and for wrongly handpicking technologies instead of standardizing interoperability.<sup>26</sup> Client

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<sup>16</sup> <http://www.eclipse.org/>

<sup>17</sup> Business Intelligence and Reporting Tools <http://www.eclipse.org/birt/>

<sup>18</sup> Visual Editor Project <http://www.eclipse.org/vcp/>

<sup>19</sup> [http://wiki.eclipse.org/index.php/JFace\\_Data\\_Binding](http://wiki.eclipse.org/index.php/JFace_Data_Binding)

<sup>20</sup> Refer to <http://wiki.org/wiki/cgi?WhatIsWiki> or <http://en.wikipedia.org/wiki/Wiki> for an introduction, use <http://plone.org/> or <http://trac.edgewall.com/> or one of the hundred other Wikis.

<sup>21</sup> <http://subversion.tigris.org/>

<sup>22</sup> <http://maven.apache.org/>

<sup>23</sup> <http://www.e-government-handbuch.de/>

<sup>24</sup> <http://www.kbst.bund.de/saga>, in English [http://www.bsi.bund.de/english/themes/egov/3\\_en.htm](http://www.bsi.bund.de/english/themes/egov/3_en.htm)

<sup>25</sup> [http://www.bitkom.de/politik/814\\_2300.aspx](http://www.bitkom.de/politik/814_2300.aspx)

applications may be used only if the functionality of a web browser is “inadequate”, explicitly naming business transactions with direct file system access or interaction with legacy software. Although these requirements are difficult to achieve from the browser sand box, this viewpoint is not neutral.

As a living document and probably as reaction to the critics the recent versions addresses “offline-clients” and “OSCI-clients” a bit more, but its scope is still mainly for browser-based applications. Smart client technology has several additional advantages over web clients, e.g.:

- Interactive user interfaces with responsive and user-supporting desktop look and feel
- Usability of complex widget types without increasing the security risk for the browser sand box
- Better user interface reactivity; also AJAX<sup>27</sup> and other frameworks address this problem<sup>28</sup>
- GIS-features are provided easier than with web-clients where GIS functionality normally leads to specific browser types and even version restrictions
- GUI<sup>29</sup>-Integration for local applications, Open Office<sup>30</sup> or legacy systems for instance, and even web pages
- Independence of browser versions and security updates
- Lower bandwidth usage and more available caching strategies

Some of these advantages are typical fat client features and administration staff rightly complained about the work spent with the installation and maintenance of fat clients. But technologies like Java Web Start or Eclipse Update Manager out dated this objection.

Yet the installation process is the main disadvantage and it is the distributor’s challenge to gain the users trust first, but governmental authorities are not known to be a source of spy-ware or viruses and generally trusted. Third party reviews, certificates and their validation add professionalism to the degree of trust but the offline storage capability is probably the main motivation to install E-Government software, or would you like to store your tax declaration tryouts on the servers of the fiscal authority?

Rich clients are installed with their own components and only reachable by other trusted software already having about the same level of access rights. Internet browsers deal differently with the same content. Usability tests and effort are required much more frequently, especially when bypassing the browser sand box, e.g. for additional GUI-functionality or local storage access. Opening the browser sand box breaches a security wall built and used to contact unknown sources and therefore is not desirable.

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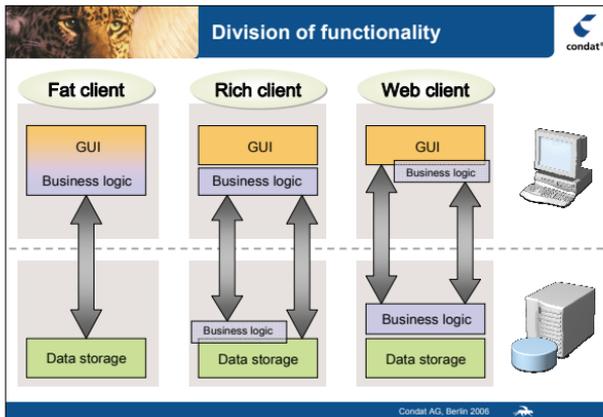
<sup>26</sup> <http://www.fokus.gmd.de/web-dokumente/eGov-Slides-pdf/Kaczorowski-Vortrag.pdf>

<sup>27</sup> Asynchronous JavaScript and XML (AJAX), an introduction might be <http://en.wikipedia.org/wiki/AJAX>

<sup>28</sup> But the JavaScript security problem to the browser sand box remains.

<sup>29</sup> Graphical User Interface (GUI)

<sup>30</sup> <http://www.openoffice.org/> and <http://ubion.ion.ag/loesungen/003officeintegrationeditor>



After all, objective requirements and usage scenarios should determine the selection of technology. If more than mere data input is required, like access to data entered in the last year, smart/rich clients might be the better choice.

Nonetheless, SAGA also demands n-tier architecture and basic requirements like operating system independence, reliance on XML as basis of the communication protocol and other accepted standards for E-Government applications. And it requires the use of real and quasi standards like Online Services Computer Interface (OSCI)<sup>31</sup> in combination with a virtual post office to ensure trusted XML communication, DOMEA<sup>32</sup> for electronic records management, E-Payment and a good number of requirements to build interoperable (web) service oriented architectures.

In a few years signature cards or digital identification smart cards and card readers will be commonly available and the already existing virtual post office will implement the Certificate Practice Statements (CPS) and validate email messages for confidentiality, integrity, authenticity and obligation. The classification of the EKVO protection requirements has to be completed first, too.

This will be realised with an application based on the Eclipse-Rich-Client-Platform. This application is usable on all operating systems for which Java/Eclipse is available. Because of its plug-in architecture the platform offers the possibility to build complete applications from various available plug-ins or even add new functions after the installation. The software will be distributed via mouse click in the internet and on CD-ROM.

Also reporting, queries, online help and plausibility checks are realised with this modular system. The experts can create the business features of the software by themselves and easily add these to the complete application. By using automatic update mechanisms, modifications which have been created after completion of the application will be distributed automatically to users with an active internet connection.

<sup>31</sup> <http://www.osci.de/>

<sup>32</sup> Document management and electronic archives in IT-supported business processes (DOMEA) <http://www.kbst.bund.de/domea>

#### 4. Conclusion and outlook

The application can be changed model-based. This means that data models for objects like districts or sewage plants can be designed by means of UML (Unified Modelling Language), further descriptions like workflows, queries and elements for the user interface are added via descriptive/domain models.

From these specified descriptions the complete application is created by generators in interaction with configurable software modules; thus considerably reducing the amount of code to be written manually. New application components or modifications of existing components can be realised much faster by using this method. At the same time they are more stable, as the automatically generated code always follows the same pattern.

The software development is strictly aligned to those tools which are not only able to increase the usability, performance, stability, scalability, maintainability, expandability and reusability but also to reduce the development costs from the beginning.

The greatest advantage is the long term availability of the process models completely detached from technology issues. The viewpoint of organizational optimization has to be the starting point for all activities. And these models flow seamlessly into sublevels like the Business Process Execution Language (BPEL)<sup>33</sup> and concrete component interface definition and implementation.

This software platform can be used as a pattern for other environmental domains to provide data entry and transmission to the responsible authorities like federal states, countries or the EU. It is designed to fulfil self-monitoring and reporting obligations of each Member State as demanded by the EU, according to the "General Principles of Monitoring" and E-Government standards.

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<sup>33</sup> <http://www.oasis-open.org/committees/wsbpel>