SIRS Dignes 2.0: A Cooperative Software For Levees Management

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Abstract. SIRS Dignes is a computing tool that makes informations on levees more durable and accessible in order to enhance their management. The first version of the software, which was IRSTEA's initiative, was deployed in 2004. The second version was released in 2015. This article aims at pointing out the innovative aspects of this last version. They concern thematic and functionalities, computing technics and architecture, and last but not least, the business model chosen in order to build a long lasting software. The software's kernel is sketched to propose a general description of levees: it focuses on description of the levees and linked objects, on disorders that affects them, on works... Most of these topics were already broached by the first version. The kernel of the version 2 may be extended using optional thematic modules. These modules concern: vegetation monitoring, reporting (in coherence with current French regulatory requirements), riverbanks, riverbed... Main functionalities performed by SIRS Dignes V1 and V2 are : data structuring and centralisation, quick access to relevant data, reporting and mapping, etc. SIRS Dignes 2.0 updates and improves already existing functionalities of the first version. SIRS Dignes V2 relies on an document-oriented NoSQL database, CouchDB, and on geospatial libraries, Geotoolkit and Apache-SIS. SIRS Dignes V2 was released with a copyleft license. Copyrights belong to the French levees managers' society, "France Dignes", which acts as a cooperative. Members put their heads together in order to gather their financial capacities and fund software development. France Dignes has got the technical and thematic expertise and supply various services to the members. This business model aims to ensure accessibility, durability and adaptability of the software.

1 Context

The very first idea of SIRS Dignes appears in the early 90's. The context is of an increasing flooding hazard in France and all over the world. The topic is put in the front scene and simultaneously, the idea of a computing tool emerges in IRSTEA's scientists' minds (IRSTEA is Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture). This tool enables users to centralise, capitalise and access data.

From the 90's until nowadays, levees management has been performed in France by public organisms of various size and nature. Their human and material resources and their competences were unequal. A computing tool dedicated to assist managers in their daily duty was a potential means of building bases of a community of practices.

IRSTEA carried out the preliminary studies for conceiving such a tool. In the years 1999-2000, other studies were conducted to build a data model as generic as possible and fitted to most levees. A prototype was built up for a particular levee, along the Loire River, in

order to help the managers to better understand the potential of the tool. In 2000-2002, two levee managers joined the project partnership. They decided to fund the final GIS application development. During this period, IRSTEA remained a partner and provided technical assistance.

In 2004, AD Isère Drac Romanche and Symadrem (syndicat mixte interregional d'aménagement des digues du delta du Rhône et de la mer) were owners and users of an operating computing tool. They looked for new partners to mutualise maintenance costs. They share the ownership with a third structure, DREAL Centre (direction régionale de l'environnement de l'aménagement et du logement de la Région Centre), which is the representative of the French state at the regional level.

After several years of use among 1200km of levees, it seemed necessary to go one version higher and even to deeply refund the application. Main evolutions concerned technical architecture, components, life cycle monitoring. The aim was to build a tool that would be more attractive

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for new users: intuitive, reliable, accessible, available and open, easier to maintain...

The SIRS Dignes 2.0 was born from this process of reengineering. It was released in early 2016, the 23rd of February. It still addresses mainly the same functionalities as the first version.

As levees managers are geographically concentrating and their field of competences is widening these functionalities adapted. France Dignes, the national association of French levees managers, hatches those evolutions through its members and through SIRS Dignes software.

2 SIRS Dignes V1: Levees managers' needs

Enhancing levees management: there are about 9,000 km levees in France. They are very heterogeneous, not well known and often in bad condition. Gathering and managing informations on levees appears as a central problem in daily and flood management.

Another central concern is the restitution of gathered data: they need to be quickly accessed in order to obtain more relevant levees diagnostics and proceed to quicker and more adapted interventions, including in case of flood event. Geographic dimension of data has to be taken in account. Objects are usually positioned along levees and rivers by a linear referencing system. Some old levees use several referencing systems, which have been used to describe and locate different objects (ie breaches). SIRS aims at referencing and locating this location in another coordinates system: either another reference system, or by determining its distance to bounds located on or beside the levee, or in classical (x,y) coordinates.

This tool is mainly dedicated to levees managers, which has required precision in location (a few meters) and relevant functionalities:

It describes the inner structure of the levee (crest, levee slope and foot, basement, etc.), the regulatory organisation, various networks (roads, hydraulic, etc...), disorders, hydraulic events, any documents.

Figure 1. levee cross section modeling

When objects are out-of-date, after works on a structure for example, they are not deleted from the database, but archived by adding an end-of-validity date.

These needs are fulfilled in both versions of SIRS Dignes.

3 The SIRS Dignes process of evolution, from first to second version

3.1 Areas of improvement for SIRS V1 to SIRS V2

3.1.1 New needs and new functionalities

Adaptation to new regulatory obligations (levees act on 12th Mays 2015) mainly requires the development of two additional modules and the possibility to create reports masks in order to extract pre-formatted data from SIRS Dignes database. The tool also allows regulatory documents tracking.

In France, levees are managed by very heterogeneous organisms. The first SIRS Dignes users had their activity dedicated to levees management, but no involvement in rivers management. From now on, potential users will have a global mission, centered on the river and its environment. In this context, two news modules have been created, for river bed and riverbanks management.

Since the first SIRS Dignes release, the need for a terrain mobile device has emerged; working with paper sheets is very often tedious. Information and communication technologies now allow providing a solution to this need.

Another early identified need is to be able to share databases access between several users, on internal or distant servers, by solving synchronisation and simultaneous access aspects.

Finally, SIRS Dignes must integrate technical and financial cooperation so that intellectual, financial and human contributions can be included in a transparent way.

Figure 2. a levee in SIRS Dignes V2

3.1.2 Architectural and technical improvements

It concerns several points that will be highlighted in 3.2:

- They will be one desktop application (the “kernel”, gathering generic thematic) and several modules (figure 3). This architecture allows the software to be technically maintained more easily. It makes it easier to comprehend for new users too,
- Using Open Source proven components maintained by their own communities is recommended. Situations of “vendor lock-in” are to be prohibited. There must be no dependency on closed components,
- The programming language(s) will be long lasting so that they have the benefit of a large community of developers and many development tools,
- GIS and DBMS components will be replaced by open source solutions.

Figure 3. SIRS Dignes V2 and its modules

3.2 Objectives of the reengineering: better manage evolutions and maintenance

The first version of SIRS Dignes, developed between 2002 and 2004, is a GIS application relied on a DBMS (Access®) and a GIS (ArcView®). The SIRS Dignes software was composed of two distinct applications that accessed the same geodatabase. The main one was integrated in ArcMap as a specific toolbar.

AD Isère Drac Romanche, Symadrem and DREAL Centre own the part of the computing code that was developed as part of the original public contract. This code is not independent from ArcView and Access and is therefore useless by itself. It cannot be compiled nor be executed and works only with ArcView, Access –which require payment for the licence and maintenance. A piece of code belongs to the initial contractor and potentially blocks any reworking from anyone else.

The first version was deployed in 2004 along the river Isère, then in Camargue and afterwards along the river Loire (DREAL Centre) in 2007.

Once the corrective warranty was over, a public contract for application maintenance was set up. Apart from the initial development, it is indeed costly to maintain an application: it has to adapt permanently to

new technical context, to new users’ needs, and remaining bugs have to be fixed.

AD Isère Drac Romanche, Symadrem and DREAL Centre wished to share their computing tool in order to share maintenance costs. Several attempts to distribute the application under a closed licence were made. But no satisfying method has ever been found to attribute a fare cost to the licence. Owners were in a cul-de-sac concerning costs sharing...

From 2004 till 2016, many experiences and requests for modification of the application have been capitalised and analysed [2]. Most of the requests have been dealt with by software maintenance. But others have been kept apart because they required a deep change in entire application (ref article colloque digues 2013): aside from classical requests for enhancing human engineering, or adding new functionalities (users’ needs had evolved), the main demands of evolution concerns computing technics: non efficient or aging components, maintenance and evolution difficulties (problem of proprietary lock-in, which makes users dependant of the vendor services and products).

Needs for a general reflexion about the application life cycle emerges.

3.2.1 Life cycle management

Users and developers manuals, technical documentations must exist and be well prepared, in order to facilitate future exchanging and transferring knowledge among various actors of the life cycle of SIRS Dignes (successive developers in particular).

A community of users is to be identified, motivated and livened up. It has to be as wide as possible.

In order to limit the risk of « forking » -very low with a technical and specialised tool like SIRS Dignes- and keep control on future evolutions, France Dignes has to be the leader of the community, maintaining a strong dynamism of evolution and community life. France Dignes must be able to propose a professional and technical expertise to SIRS Dignes users.

The openness of software can be defined as the wide accessibility of executable or computing code or documentation for any user (open licence of software and components). The openness is as well the possibility to use SIRS Dignes data with other softwares and tools thanks to using open computing formats and complying with the standards.

Activity must be maintained, knowledge shared and capitalised; all actors of the project must find a practical interest in being a part of the community. More the SIRS Dignes will be part of the daily work of numerous actors, the longer it will last.

A bug report tool will be used as well as a systems allowing computing code standardisation, in order to make its handling easier.

The software will be promoted through various free and paying services.

3.3 How to achieve these objectives?

3.3.1 A new actor appears: “France Dignes”

The idea of a professional association for levees managers emerges among SIRS Dignes users’ group. They regularly debate general subjects concerning levees monitoring as a whole. They gather around the SIRS Dignes but are interested in sharing professional experiences, techniques and savoir-faire. They thought that other managers could be interested in contributing. The idea took shape with the publication by French government of the “Plan de submersion rapide” (PSR), one year after the Xynthia storm (2010). France Dignes was officially born in May, 2013. It is a new element in the reflection about SIRS Dignes version 2.

Figure 4. France Dignes logo

France Dignes has been in charge of technical monitoring of the preliminary study and of SIRS DIGUES 2.0 development. Copyrights of the second version belong to France Dignes. It has the job of implementing community and financial conditions required to ensure durability of SIRS Dignes 2.0.

The new version was co funded by the French Government (DREAL Rhône alpes -40%- and DREAL Centre -10%-), the FEDER “Plan Rhône” (30%), AD Isère Drac Romanche (10%) and Symadrem (10%). One condition for public funding (DREALs) was that the licence of the final product would be Open Source AND free.

The conditions to fulfill the objectives of the process are therefore:

- The license has to be open source (that is to say : anyone can freely copy, use, adapt and re-share the application)
- The organisational conditions must be set up in order to ensure that France Dignes will be able to face maintenance’s costs as well as animation of the project.
- The tool has to address users’ needs described further up as well as to integrate general professional activities of a larger community constituted by France Dignes members.

The preliminary study, performed by Artenum, allowed clarification of objectives and means to achieve them. They made proposals for technical and organisational enhancement of SIRS Dignes V1.

4 SIRS Dignes version 2.0

4.1 Architecture and computing techniques

The main characteristics and components of SIRS Dignes architecture are the following ones:

4.1.1 GeoToolkit, a geospatial toolkit for geomatic calculation and display

GeoToolkit, an Open Source geospatial library developed by Geomatys, has been used for linear spatial referencing and map display. It is the only one Open Source projects to implement linear referencing but also precise data re-projection, styling and rendering.

4.1.2 A connectable all-platforms thick client application

The architecture analysis lead to choose a thick client application, as some users need to use SIRS Dignes 2.0 in a standalone context: small infrastructure, without any shared central server or connection to the internet. But some users also need to use the software in a network context: large infrastructure, with real-time data access and share. In addition, SIRS Dignes 2.0 has to be compatible with all operating systems (OS), as there is no standard OS within the users’ community. For all these reasons, a NoSQL database with a Java User Interface has been chosen, letting users run the software in all material situations without any data loss.

4.1.3 A NoSQL database to store all data

Apache CouchDB, the NoSQL database project run by the Apache Foundation, has been chosen for its popularity and support. The remarkable aspect of a NoSQL database is the storage of all data in “documents”, without any explicit SQL structure. Document metadata contains revision information, making it possible to merge any differences that may have occurred while the databases were disconnected.

SIRS Dignes 2.0 comes with a local CouchDB database, which can be synchronised to another database that may be installed on a central server or on a colleague’s computer, for small infrastructures. SIRS Dignes 2.0 does not manage data synchronisation, as it works with a local copy of the database. Data synchronisation is operated by the Apache CouchDB database server in its native functionalities.

4.1.4 Online and Offline operation

The NoSQL architecture and database replication allows users to work offline on their local database. When network connection is retrieved, the local database is automatically synchronised with the “mother” database. As all records are considered as independent documents, there are no identifiers conflicts, as there would be in a SQL database.

In a SQL architecture, two users cannot add data in a shared table without locking it online for an exclusive use. It is a huge threat to offline use and cooperative work.

On the contrary, a NoSQL database can be operated offline by several distinct users, and all documents modifications or additions are reported in all the connected databases when network connection is retrieved.

4.1.5 Java as a multi-platforms programming language for all operating systems compatibility

Java has been chosen for its performance but overall for its compatibility with all operating systems (Linux, Windows, MacOS). A software written in Java is not run directly on the computer where it is installed, but on a “virtual machine”, called “Java Virtual Machine” (JVM), which is a background software that provides the Java Software with all the computer’s resources. Thus, SIRS Dignes 2.0, written in Java, can be either installed on Linux, Windows and MacOS computers.

For policy updates reasons, Java Virtual Machines may not be updated by network administrators on regular bases. For this reason, all-in-one (JVM+SIRS Dignes 2.0) releases of SIRS Dignes 2.0 are available on the project’s server.

In addition, Java code is integrated in an ergonomic User Interface, called JavaFX, used to design graphic parts of the software, including windows, buttons, drop-down lists, ... Software updates are managed by internal Java components, and do not require high technical skills from the user.

4.1.6 SIRS Mobile, an Android-based toolbox

For mobile implementation, the same open source architecture has been chosen, but limited to Android as other operating systems do not provide free development kits. The IONIC platform provides a web-based User Interface, with a local NoSQL database to be synchronised with Apache CouchDB. Thus, the same online/offline behaviour as the desktop software has been reproduced, letting the user read, input and modify his data anywhere in his geographic professional context.

4.2 Sharing resources and co funding

SIRS Dignes 2.0 is distributed under a copyleft licence (GPL3.0). Such a licence stipulates that the derivative works will be copyleft as well.

Open source licence is a factor of community dynamisation. It is a vector of promotion too: anyone can test, evaluate and study the product freely, on condition that one has the skill for it. Open source is generally an argument for quality, especially when the users’ community is wide.

Copyleft licence permits diffusion control and avoid appropriation of derivative works in a commercial context.

New modules can be closed license.

France Dignes is favourable to open up the software to competition, to encourage knowledge sharing and capitalisation. In the meantime, the issue is to keep the leadership of the project, maintaining a dynamic of

evolution, proposing specific tools to the community as well as dedicated services and expertise and centralising financial resources necessary for maintenance, evolutions and life cycle monitoring.

France Dignes will propose various services to the users’ community:

- A dedicated website will allow users to download executables, source codes and documents,
- Other tools will be made available for users: a forum, a faq (frequently asked questions), a bug report tool,
- Various services will be proposed by France Dignes to the users’ community: contracting authority support, training, etc.,
- France Dignes will call for financial funding inside the community (members or non members). Decision making processes are thought about and set up in common.

France Dignes has put in place services and co-funding rules in sight of keeping its financial balance along the years. Members took part in the reflection. Setting up the applicative maintenance is the first subject to which these rules can be applied.

France Dignes’s goal is not to collect all the activity around SIRS Dignes, but, on the contrary, to organise and promote the software community.

5 Perspectives

France Dignes is already thinking of further developments and tools, which is part of its general objectives. During the development and the preliminary needs assessment, it has appeared that there would be a great demand for a new tool for integrated rivers and riverbanks management. French levees managers have more and more to handle with the whole river, in its various aspects. The same business model is likely to be used for future developments as well.

6 References

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