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Three years of experience with the SoDa web service delivering solar radiation information: lessons learned and perspectives

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Abstract

Information on solar radiation is a critical issue in several environmental domains as well as for sun-powered systems. The present means for accessing information by users present several severe drawbacks. Three major problems were identified and should be solved to supply users with relevant information: improved access to information, improved space and time description / knowledge of the radiation field and related quantities, improved matching to actual user needs. The SoDa project was launched (2000-2003, IST programme of the European Commission) to bring solutions by an efficient use of advanced information and communication technologies. An integration of information sources of different natures was initiated by the SoDa Intelligent System (see online at http://www.soda-is.com). These sources include databases containing solar radiation parameters and other relevant information; several of them originate from the processing of images taken by satellites. The sources also include user-oriented applications. The successive prototypes of the SoDa Service were validated through users trials. The outcomes of the project SoDa represent a significant step forward beyond the current state of the art and include substantial original work. The main innovations of SoDa are to offer a smart access to diverse networked sources of information that are geographically dispersed, and to supply users with information of high quality. Surveys of users demonstrated that large gains in terms of efficiency, costs, etc. were expected by engineers, companies, agencies and research institutes if relevant information were more easily available for virtually any geographical location at any time. Accordingly, it was decided in 2003 to create the SoDa Service and to operate it. During these past three years, the SoDa Service underwent several improvements, all aiming at consolidating it with respect to access by users. Improvements were made on the SoDa Intelligent System, including works on the user interface and on the presentation of the services. Promotion efforts were made towards media, including TV. The effective use of the SoDa Service is increasing from year to year. In 2003, 2000 requests for information were satisfied; in 2004, 20 000 requests; 35 000 are expected in 2005. This communication presents the lessons learned from the past and the perspectives of the SoDa Service. We discuss the sustainability of the SoDa Service, the technologies used and the approach to customers, in the perspective of developing a B2B merchant site.

1. Introduction

Information on solar radiation is a critical issue in several environmental domains as well as for energy production by means of solar-powered systems. Well-controlled measurements of radiation are available in a limited number of sites. Outside these sites, models are applied to infer the radiation from measurements. The results are usually not satisfactory and there is a large discrepancy between user request and available information (Cros et al. 2004). Large gains in terms of efficiency, costs, etc. will be attained by engineers, companies, agencies and research institutes if relevant information were more easily available for virtually any geographical location at any time (Bourges/Kadi 1995). Recent projects have demonstrated the usefulness of image processing techniques for extracting solar radiation information from Earth

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observation satellite images (Rigollier et al. 2003; Mueller et al. 2004). Reliable validated routines have been established at some meteorological offices and research institutes. Efforts have been made to collect, store and disseminate solar radiation information. Several databases are now available on the Internet (Fontoynont et al. 1998; Lefèvre et al. 2003) or in CDs (ESRA 2000; MeteoNorm 2003).

However, these efforts are not sufficient enough. Three major problems were identified and should be solved to supply users with information relevant to their requests: improved access to information, improved description and knowledge in space and time of the radiation field and related quantities, improved matching to actual needs (Cros et al. 2004). The project SoDa used the considerable previous experience as a springboard to answer users' needs by an efficient use of advanced information and communication technologies. It was sponsored by the IST programme of the European Commission from 2000 to the beginning of 2003. Several information sources of different natures were integrated within a smart network on the web (http://www.soda-is.com). These sources include databases containing solar radiation parameters and other relevant information. Several of these databases originate from an advanced processing of satellite images. The sources also include user-oriented applications. Several domains were under concern: environment, vegetation, climate change, oceanography, health, energy-conscious building design, renewable energies, daylighting and material ageing and weathering.

The SoDa Service represents a large improvement in access to information in solar radiation by users. Having a common access point makes it easier to users who do not have to remember and store several URLs (one stop shop). The standardisation of the interfaces querying the space and time attributes of a request and the adoption of standards for describing these attributes are also facilitating the uptake by users. The standardisation of the outputs is a major improvement. Before, users were spending efforts to cope with the various formats produced by the various meteorological offices. The large efforts spent in the selection of the most appropriate chaining of proven algorithms to answer needs beyond measurements are improving access to information. By making these chains available, the SoDa Service offers the most accurate way to get the information. This is enforced by its networking capabilities. Since any provider can easily declare an application, the SoDa Service is capable of shifting from one application to a more appropriate one and consequently is capable of offering the best service available. Another innovation is to supply users with information of high quality. High quality means an improved matching to actual needs: the supplied information better answers needs than raw observed data would do. It also means improved time-space coverage and improved time-space sampling.

Three prototypes of the SoDa Service were built during the project. All were gauged by several tens of users who thus contributed to the re-engineering of each prototype. As a whole, user expressed satisfaction. The surveys show that several benefits are expected besides technical innovations in all areas where solar radiation makes significant impacts. Given the high expectations of users, an operational SoDa Service was set up in January 2003. It is gradually being recognized by professionals and its effective use is increasing. In 2003, 2000 requests for information were satisfied. A request is an access to a set of data or the execution of an application. In 2004, there was 20 000 requests; 35 000 are expected in 2005. A market analysis made during the SoDa project by the Italian company iCons showed that a market niche exists for such a service. Nevertheless, the market was not ready. Accordingly, the SoDa Service is presently run on a free-access basis in order to increase its visibility and gain experience in running an operational service and exploring market opportunities.

This communication presents the lessons learned from these past years and the perspectives of the SoDa Service. We discuss the sustainability of the Intelligent System itself, the technologies used and the approach to customers, in the perspective of developing a B2B merchant site.

2. The SoDa Intelligent System

The SoDa Intelligent System (SoDa IS) is a set of pieces of software that are central to the SoDa Service (Wald et al. 2002). It performs the integration and exploitation of diverse networked information sources that are geographically dispersed. It offers a common access point implemented as an Internet server. The user request may be beyond the content of the available databases. An example is the sizing of photovoltaic panel for producing enough electricity for home appliances. To that end, the service includes specific applications and the SoDa IS can combine databases and applications. The SoDa IS is flexible and is capable of integrating other databases and new application-oriented algorithms, as demonstrated by several services (databases and applications) provided by institutes not members of the SoDa project. In that sense, the SoDa Service and its Intelligent System can be seen as an efficient means to validate scientific expertise and to perform transfer of knowledge from researchers to practitioners.

The SoDa IS relies upon available and reliable data exchange protocols and on systems to guide, connect, and transfer data across computer networks. Applications are interfaced to the Web at the premises of providers. The SoDa IS has several functions that are detailed hereafter. Firstly, it helps to thematically organise the available services (databases, applications) and subsequently provides a means to dynamically discover the contents of the SoDa Service. Once a service is invoked, a Graphical User Interface (GUI) is built that is specific to this service. The service is executed, results are formatted by the SoDa IS and presented to the user. A XML schema was defined for the exchange of information between the SoDa IS and the various services (databases, applications) that are called upon to execute a request. All applications are described in XML in the SoDa IS. The adoption of the XML is a definite advantage with respect to the adoption of the SoDa Service by providers for publishing their databases and applications. They do not have to change their own format; a simple cgi script converts the SoDa XML into the metadata used by the service provider.

The HTTP based Geo-Temporal Searching (HGS) technology was used in the first versions; it defines a mechanism whereby remote databases can be searched through a single standard HTTP interface (HGSS 2003). It provides a Service Discovery layer. This allows online retrieval of a hierarchical structure of all databases available for search and all applications that can be invoked through HGS. The catalogue of services comprises a Service Descriptor for each service, written in XML. These Descriptors are exploited by the HGS to offer an up-to-date catalogue to users.

Once a service is invoked by the user, the SoDa IS reads another XML file whose URL is defined in the Service Descriptor (Fig. 1). This file contains metatags describing the content of the Graphical User Interface (GUI) that is specific to each service. Nevertheless, because they are very common, standard user interfaces were defined for the description of the space and time attributes of the user request that are automatically called when launching an application. In that way, it facilitates the declaration of an application. From the user point of view, it permits to present the applications in a homogenous way. These interfaces are defined in the SoDa XML as metatags. Figure 2 is an example of a GUI that is dynamically constructed by the SoDa IS. The map is built by exploiting a Geographical Information System by the means of the MapServer tool (2005); the coordinates are defined in the XML file for a service. The user fills in the requested parameters for this service and then executes it.

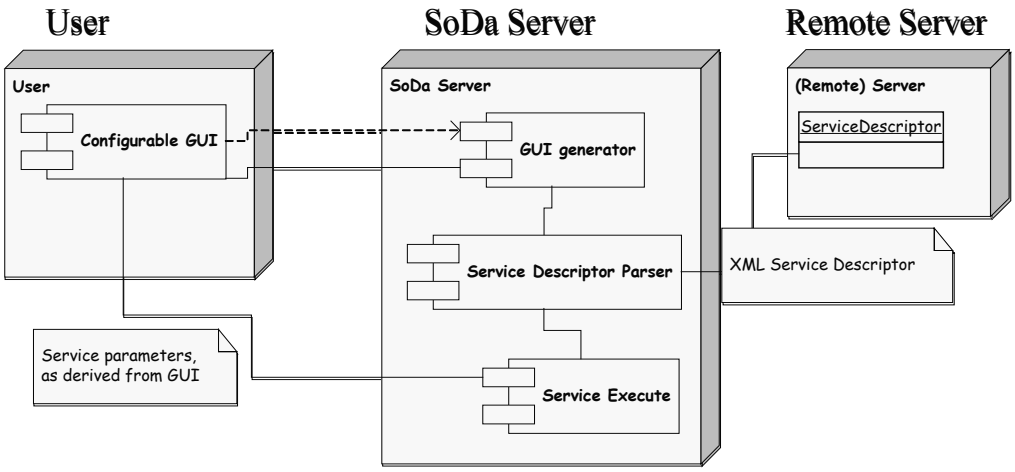

Figure 1. SoDa Service Invocation

The outputs of a service are expressed in XML. A converter permits to shift to HTML at user's will or to any customised XML using a XML style sheet selected by the user. Several XSLTs (eXtended Stylesheet Language Transformation) were written for that purpose; one produces "comma separated values" (CSV) ready to be ingested in standard spreadsheets.

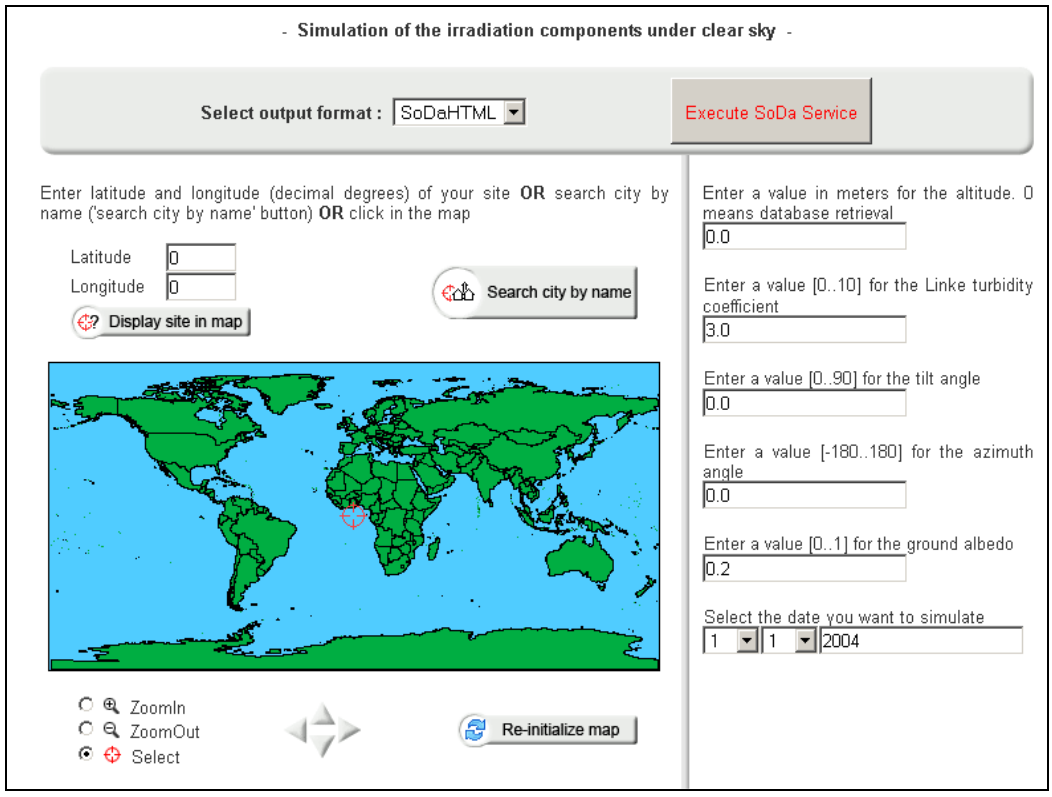

Figure 2. Example of a GUI constructed by the SoDa IS (2005)

3. Converting SoDa project outcomes into the SoDa Service

Close to the end of the SoDa project, a consultation of users was made through on-line questionnaires (70 returns) and a users workshop was held in Paris in November 2002, gathering 20 selected users, representing a wide panel of professionals in solar radiation. The outcomes of these consultations and workshops praised the usefulness of such a service, its potentials for filling in users' expectations, the overall quality of the information delivered and the recognition of the high degree of expertise held by the SoDa project consortium. Users said that the SoDa Service is an efficient means for transferring highly specialized knowledge from researchers to practitioners and encouraged the transformation of the prototype into a sustainable SoDa Service. However, users clearly stated a lack of visibility for this consortium that may impede the sustainability of the future exploitation of the SoDa Service, the lack of action for promoting the SoDa Service and on a more technical ground, the difficulty of finding appropriate applications in the 2002 prototype of the SoDa Service.

The market aspects were also covered. The question "are you ready to pay for data and other information" divided users according to the domain of activity: when this domain may be profitable for companies, they are ready to pay. Companies are more inclined to purchase information than public administrations or research organisations. Besides the sales of information available in the SoDa Service, there was a clear demand for consultancy and training. The basic data were expected to be given for free, following the example of the meteorological data in USA and contrary to the current procedures in Europe. In any case, users underlined that selling information requests a clear identification of the vendor which should be known, capable and reliable, and a clear identification of the benefits brought by the SoDa Service compared to current practices.

In the view of these outcomes, the SoDa project consortium decided to operate the SoDa Service on a self-funded basis during one, then two years. In 2003, Ecole des Mines de Paris / Armines (EMP) decided to take full leadership of the exploitation of the SoDa Service because we strongly believed in its usefulness and in the smart technologies sustaining the SoDa IS. While the other partners agreed to maintain their applications, we undertook several activities to develop the SoDa Service. The activity in 2003 was to transfer the SoDa IS from its creators (JRC in Ispra) to our premises. The SoDa IS was mostly written in Java (servlets and applets). This implied training for our team, which was not conversant with Java. In Summer 2003, the operational SoDa Service became that of EMP and that of Ispra was shut down. Prior to improvements, in 2004, a model of the SoDa IS was built in UML (Universal Modelling Language) to better focus changes in software. Improvements were made then on the GUI, in particular, the selection of a geographical site by the means of a gazetteer. At that time, users feedbacks clearly showed that Java applets were posing a problem to several of them: for various reasons, they do not have the capability of installing Java on their own PC and consequently, a significant number of potential users was unable to launch applications in the SoDa Service. In Summer 2005, all Java applets were removed and replaced either by HTML code for the Service Discovery or by a PHP code for building the GUI.

Beside these technical changes, a strategic reflection was conducted on the future of the SoDa Service. We had to switch from a prototype service, providing access to a wide range of domains, to a professional one, not covering all domains and addressing preferably the most active users in solar radiation. These selected domains are believed to offer potential development for marketing the SoDa Service. A strategic plan was set up, which guides the whole process of re-designing the SoDa Service. The web site soda-is.com was re-designed to favour the approach of professionals to the SoDa Service. These users must be able to find the right information in seconds and should not be wandering in a fuzzy and complex structure gathering heteroclite services as it was in 2004. A first activity was to re-design the catalogue of services; it was previously ordered by type of information, i.e., daily data, advanced parameters, user-oriented applications. The new catalogue is ordered by domains, e.g., air quality, meteorology, solar energy systems, etc. In addition, help and examples of resulting products were developed. Simple yet efficient folders and

menus, reflecting this domain-driven approach, were developed; new items were added, such as FAQ, Help, Cases Studies, Examples, moving from a research project web site to a clear, well-structured and professional one. Finally, the entire web site, originally in English, was also translated into French.

Actions were made toward medias in order to promote the use of information on solar radiation and accordingly the SoDa Service. The company Gedeon, from Paris, made several stories for TV for adult and children audiences. These stories display several cases studies showing real usage of the SoDa Service. The story about skin cancer highlights how the SoDa Service enables oncologists to know the exact level of their patients' exposure to natural UV. Two stories shows that the SoDa Service helps architects to size the number of solar panels that any particular European house would need to produce electricity to cover domestic needs. The last one about air quality describes how the SoDa Service is used by meteorologists to better know the intensity of radiation, enabling a better forecast of ozone levels in cities. These stories were broadcasted in the Eurovision network, gathering publicly-owned broadcast companies in Europe. Excerpts of the stories are available at Youris.com, a video web portal for the IST program. Stories were also published in specialised magazines. Two interviews were conducted from radio broadcasters.

Referencing the SoDa web site to major search engines and portals was a time consuming effort. Currently more than 37 different search engines including Google, Inktomy-Slurp (Yahoo.com), MSNBot (Microsoft), WISENutbot (Looksmart), Ask Jeeves, Alta-Vista, AOL, regularly browse, extract and classify SoDa web documents. In addition, we continuously monitor accesses to the SoDa Service. Figure 3 shows that the number of visits is increasing from year to year, as well as the number of requests made to the SoDa Service. An on-line questionnaire (159 answers) permitted to better know our audience in January 2005. Figure 4 reports on the relative importance of the domains of usage of the SoDa Service. The domain where the SoDa Service is the most used is by far the production of energy by means of sun-powered systems -more than 1/3 of visitors- and is followed by building engineering and meteorology.

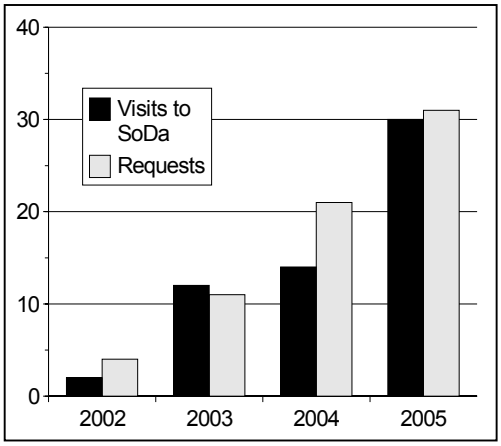

Figure 3. Number of visits to the SoDa Service and number of requests per year (in thousands)

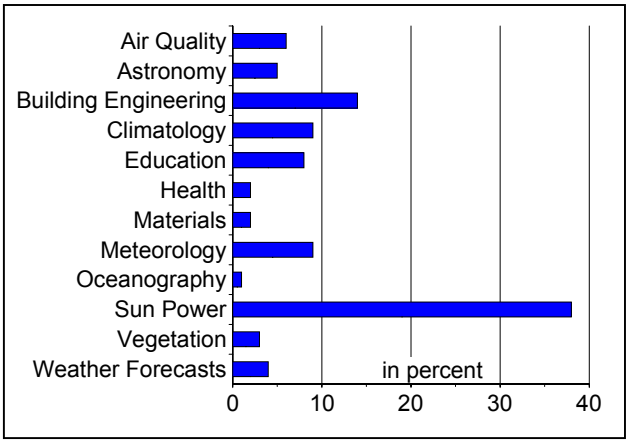

Figure 4. Relative importance of the domains of usage of the SoDa Service, in percent.

In January 2005, we subscribed to the Google Adsense program, which is a fast and easy way for website publishers to display relevant Google ads on content pages of their website and earn money. The ads that show-up on the SoDa web site generate small yet regular incomes. As they are based on the content of the web site, they really cope with the domains covered by the SoDa Service. Beside the fact that these ads give a more professional look to the web site, they also help the SoDa Service to be identified by the targeted web site as an actor in the solar radiation market, thanks to the referrer mechanism in logs files.

4. Lessons learnt and current developments

There are several lessons learnt from these past three years in various aspects: technology, the user key role, cost of investment and business model.

The SoDa IS was formerly built-up using Java technology both on the server side with servlets and on the client side with applets. The description of the content of the SoDa Service catalogue was made in XML. The choice of these languages was inherited from the European project; it was guided by the knowledge of these languages by the JRC, in charge of the technology development, and the re-use of proven pieces of software, such as HGS. Though servlets and XML are totally hidden to the users, applets are loaded in the client browser. This led to many problems due to the sometimes incomplete compliance of browsers with the Java Runtime Environment (JRE). The SoDa Service used applets for the GUI which displays maps for geographical selection of site of interest and queries parameters to be input to the remote application. It is therefore a crucial point in the invocation in any service offered by the SoDa Service. Errors occurring at that stage have a really negative impact on the perception by users of the SoDa Service. For this reason, we abandoned this applet approach and used instead PHP (a server side scripting language) as shown in Figure 2 or static HTML pages. The servlets and XML parts of the SoDa IS have been kept as they are and currently give satisfactory results.

Although users were in a key position in the SoDa project, they were at that stage perceived as contributing the technological development. We did not consider how the whole SoDa Service can benefit their business, but were more focused on providing to them very accurate services that they can use. This led in developing a complex and a more "scientific oriented" catalogue of services. A quite long and difficult reflection process enriched by interviews of users and a better listening to their concerns, permitted to move towards a catalogue which is based on domains of activity of users, with partly redundancy of services. The major goal of this approach was to increase the use of the SoDa Service by professionals and in a further stage, to be able to convert users into potential customers.

Soon after the operations began, it became obvious that the Web site of the project was focusing too much on the availability of the services and that, even re-engineered, was not appropriate to a customer approach. The change from "services-approach" to "domain-approach" permitted to build a much richer web site containing several documents that are linked to a domain and that help users in using the SoDa Service.

This three-years period of self-funded activities for improving the SoDa Service required a consequent amount of efforts. We estimate that each year, an average of 4 person/month was spent, including senior and junior engineers and students. In order to sustain our commitment to the SoDa Service, the Service itself should generate incomes that will partly support these technological efforts.

In the course of the SoDa project, the Italian company iCons analysed several scenarios for development and sustainability in 2002. Based on 10 real cases studies, four scenarios were clearly detailed:

1. "Free for All", where the entire offer is available for free with no restriction;
2. "Limited for Free", where all data and services are available for free but all, or several, with restrictions: registration, membership or sponsors…, or limitations as for the rules of access, the usage of data etc..;
3. "Mixed Free and Pay", where free plus on payment services are offered through a variety of modalities, often depending on quality, updating and formats of data;
4. "Pay", where the offer is uniquely on payment.

The study showed that the best solution for the SoDa Service is the "Mixed Free and Pay" formula. It is best suiting the expectations of users, as they are available to pay only for value-added services (tailored, customised information, targeted services, consulting and training). Although available in principle, the

actual willingness to pay is conditional upon the recognition of a real differentiation between the free and pay services available in the SoDa Service.

We are currently setting-up an e-commerce web site that will host a mix of free and pay services. In order to demonstrate the pay services, there will be actual examples of results or several of these services will be partly accessed for free. A prototype was developed using a e-commerce platform and is currently tested. The nesting of the SoDa IS inside an e-commerce platform was successfully realized. As e-commerce is not the core of our activities, we are still working on the economic and legal aspects relating to e-commerce and are looking for external partnership. We expect to be ready to launch the e-commerce web by mid 2006.

5. Conclusions

EMP has been and is still very active in many projects funded by the European Commission and is well aware of others. There is only a very few projects that lead to sustainable services. The SoDa Service is a example that still be confirmed. The valorisation of research and technological development into sustainable services is very demanding. It requests efforts in various aspects: technology, business development, marketing, communication. Only a very few research institutes are equipped to undertake such efforts and that may explain why successful projects are rarely producing sustainable services. Such efforts were made by EMP not because of the economic potentials but because we believe that the SoDa Service is a strategic asset for the development of research on solar radiation at EMP.

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