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ENVIRONMENTAL SOFTWARE SYSTEMS, Volume 8

SECOND EDITION

This volume contains a newly compiled version of the Proceedings of the 8th International Symposium on Environmental Software Systems 2009 (ISESS 2009), published by the International Federation for Information Processing (IFIP).

The original version was a USB with individual PDF articles linked together. This SECOND EDITION contains the complete proceedings as one document and has been produced with permission of the copyright holder, IFIP and IFIP WG5.11 “Computers and Environment”.

The intention behind creating this SECOND EDITION was to make those volumes of ENVIRONMENTAL SOFTWARE SYSTEMS easily available on-line which are not available through a commercial publisher.

This edition has been created based on the original PDFs on the USB. A table of contents and dividing pages between the chapters have been added. Where easily possible, a few technical and printing errata have been corrected during compilation.

Note that in the original TOC some papers seem to appear in the wrong section. However I have kept the original order synchronous with the USB, with the exception of the workshop papers, which have been moved to the last setion.

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Gaiberg, March 2015

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IFIP Conference Series

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IFIP was founded in 1960 under the auspices of UNESCO, following the First World Computer Congress held in Paris the previous year. An umbrella organization for societies working in information processing, IFIP's aim is two-fold: to support information processing within its member countries and to encourage technology transfer to developing nations. As its mission statement clearly states,

IFIP's mission is to be the leading, truly international, apolitical organization which encourages and assists the development, exploitation and application of information technology for the benefit of all people.

IFIP is a non-profitmaking organization, run almost solely by 2500 volunteers. It operates through a number of technical committees, which organize events and publications. IFIP's events range from an international congress to local seminars, but the most important are:

- The IFIP World Computer Congress, held every second year;
- open conferences;
- working conferences.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is small and by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is less rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

Any national society whose primary activity is in information may apply to become a full member of IFIP, although full membership is restricted to one society per country. Full members are entitled to vote at the annual General Assembly, National societies preferring a less committed involvement may apply for associate or corresponding membership. Associate members enjoy the same benefits as full members, but without voting rights. Corresponding members are not represented in IFIP bodies. Affiliated membership is open to non-national societies, and individual and honorary membership schemes are also offered.



IFIP Conference Series

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Experiences in Designing An Online Community to Facilitate Education for Sustainable Development

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Abstract. Over the last several decades there has been an increasing interest in topics related to sustainable development (SD). Given the increased attention by current media and literature on this topic and the increasing size of our ecological footprint, more and more citizens are becoming engaged in the discussions around SD. Many SD issues span regional and state boundaries and are viewed from a diversity of global perspectives. It remains clear that regardless of boundary or perspective, availability and transmission of quality information that facilitates excellence in research and education while enabling meaningful collaboration are critical to the degree to which sustainability is achieved. To help promote education for sustainable development (ESD), the United Nations University Institute of Advanced Studies (UNU-IAS) has recently implemented a program which seeks to provide recognition to regions that develop regionally-based, globally-accessible networks researching and advancing ESD. These Regional Centres of Expertise (RCEs) raise community awareness and promote regional and global collaboration in support of ESD within their specific regions. This paper will document our experiences in constructing the technological supports needed to advance the Regional Centre of Expertise on Education for Sustainable Development in Saskatchewan, Canada (RCE Saskatchewan). Distinctive to our experience is the development of a web-based support infrastructure created exclusively using Free/Libre/Open Source Software (FLOSS) technologies. In this paper we will discuss the general organization of the RCE Saskatchewan web system, how this organization reflects the overall structure of the RCE and its intended users, the FLOSS technologies used in its creation, the underlying rationale in using these technologies, and the resulting impacts of our decisions in the development of the RCE. We also discuss system utility and usability as indicated by our site members and provide a discussion of future directions for site design and implementation of new technologies.

1. Introduction

Sustainable development (SD) may be defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987; Keiner, 2004). Given the broad nature of this definition, the concept of SD has had different meanings for many, from both an individual-sense or group-sense shaped either regionally or globally based on a wide number of criteria (for example, political, social, cultural, economic, or ecological setting.). Although definitions may vary, no matter what the precise

definition of SD is, each one typically has an underlying focus on the preservation of the natural environment while advancing human quality of life or well-being (Arbuthnott, 2009).

Over the past several years, there has been an increasing attention towards SD including sustaining economic, social, and ecological systems. Citizens all around the globe are becoming more engaged in the topic (Getzner and Krauter, 2004; Harris, 2007). This increased attention has impacted many of our common activities and practices as many of us have started to re-think our current belief systems and assumptions about society, economy, and the environment and how they might need to be altered to meet the needs of sustainability (McDonough and Braungart, 2002; Bhaskaran et al., 2006; Arbuthnott, 2009). In this respect, education for sustainable development (ESD), supplemented by access to quality information and tools to effectively disseminate this information and constructively communicate (both regionally and globally) are critical factors in defining our success.

1.1. Regional Centres of Expertise (RCEs)

To help bring ESD to the forefront, in June 2005, the United Nations (UN) launched the Decade of Education for Sustainable Development (DESD). Understanding that “actions speak louder than words”, the UN set out to assist communities in organizing the means to develop a capacity for ESD (Mochizuki and Fadeeva, 2008). The UN University’s response to the challenge set by the UN Decade was the development of Regional Centres of Expertise (RCEs) through its Institute of Advanced Studies (UNU-IAS). These RCEs would, through research and projects in formal, non-formal, and informal sectors of education facilitate the promotion of the DESD goals in various participating communities around the globe (Mochizuki and Fadeeva, 2008).

RCEs are not to be thought of as centres in a physical sense (Mochizuki and Fadeeva, 2008). Rather, they resemble a means for building the capacity for ESD by enabling regionally-based (educational) institutions to strategically cooperate through grass-roots movements, building on regionally identified ESD themes for research and development and how best to support ESD initiatives that take into account regional characteristics. Although each RCE will focus on specific regional themes and thus build capacity for ESD regionally, they also build capacity for ESD globally in the sense that many themes relating to SD share commonalities across regions. For example, while RCE Cairo may have a specific ESD focus not relevant to RCE Barcelona, each may have similarities in terms of other aspects such as local food production in arid climates or population health. Sharing knowledge related to these similarities would lead to enriching the capacity for ESD from both a regional and global perspective.

To date there are sixty-two RCEs worldwide; RCE Saskatchewan is one of four located in Canada.¹

¹ UNU-IAS web http://www.ias.unu.edu/sub_page.aspx?catID=108&ddlID=661 (May 2009)

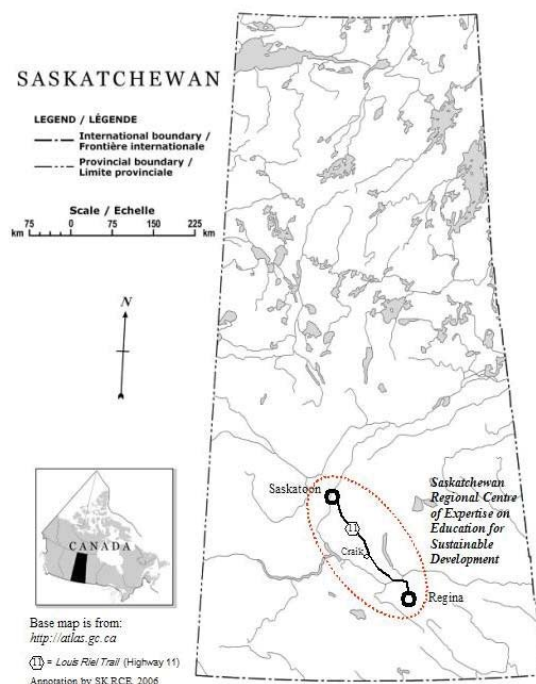


Figure 1. Map of Canada (left), with Saskatchewan in black, and map of Saskatchewan (right) with the RCE bioregion outlined in red, and Highway 11 (Louis Riel Trail), Regina and Saskatoon highlighted in black

1.2. RCE Saskatchewan

Acknowledged by the UNU in 2007 following a recommendation by the Ubuntu Committee of Peers in December, 2006, RCE Saskatchewan seeks to advance the DESD initiative regionally (See Figure 1), using a strengths-based and institutional approach. Regionally, RCE Saskatchewan seeks to bring together urban and rural areas in Saskatchewan (and the respective contributions of each) to multi-disciplinary and multi-organizational collaboration. At the same time it recognizes and affirms the ecological opportunities and constraints associated with our geographic context. In using a strengths-based approach, RCE Saskatchewan seeks to structure community, culture, and education to build greater capacity for ESD using the inherent strengths of the region (including a strong community sense of belonging, grass-roots activism, and high rates of volunteerism; Dahms et al., 2008). Institutionally, RCE Saskatchewan seeks to engage formal education (primary, secondary, and post-secondary) and non-formal and informal sectors of education within the region to advance topics relating to SD.

Specific themes on ESD that RCE Saskatchewan currently focuses on include:

- (1) Climate Change
- (2) Health and Healthy Lifestyles
- (3) Farming and Local Food Production, Consumption, and Waste Minimization
- (4) Reconnecting to Natural Prairie Ecosystem

- (5) Supporting and Bridging Cultures for Sustainable Living and Community Building
- (6) Sustainable Infrastructure including Water and Energy
- (7) Building Sustainable Communities
- (8) Sustaining Rural Communities (a cross-cutting theme)
- (9) Regionally Appropriate Educational Approaches for ESD (a cross-cutting theme)

1.3. RCE Saskatchewan's Online Community

To assist in facilitating communications and collaborations on the identified ESD themes within the RCE Saskatchewan region, an online community (OC) was developed². OCs are a type of social network; they are socially-driven, group-based online networks of citizens who share similar interests and who participate in discussions, and the retrieval and dissemination of knowledge and information on topics relating to specific interests (Preece and Maloney-Krichmar, 2003; Tedjamulia et al., 2005). Given the widespread use of various OCs in current culture (Bishop, 2006), for example, Ning-based communities (<http://www.ning.com>), Facebook groups (<http://www.facebook.com>), and MySpace (<http://www.myspace.com>), and the success they have at bridging barriers imposed on place-based only communities (such as time and geography) we decided to develop an OC for RCE Saskatchewan to help facilitate and organize ESD within the prairie region of our province. Acting as a conduit for building capacity for ESD in Saskatchewan, the RCE OC enables citizens from all around the Saskatchewan region (and globally) to have instant access to ESD content and direct links to the local (and global) ESD community in terms of events, research initiatives, projects, members and expertise.

1.3.1. Free/Libre Open Source Software

Distinctive of the RCE Saskatchewan OC is the creation of a web-based infrastructure exclusively using Free/Libre Open Source Software (FLOSS). FLOSS refers to software applications or tools that are distributed attached with source code under specific licenses that typically enable free reuse of the software, ability to apply modifications to the software code, and the ability to redistribute (and potentially fork) the software back to the open source community (Subramanyam and Xia, 2008). We selected to develop the RCE Saskatchewan OC using a FLOSS model given the inherent characteristics of FLOSS and the Free Software movement; which promote innovation and creativity through volunteerism and community enrichment (Krogh and Spaeth, 2007; Vujovic and Ulhoi, 2008). We also selected a FLOSS model to provide an example accessible to other RCEs around the world interested in developing a similar OC for their own RCE.

This paper will discuss our experiences in designing and developing the RCE Saskatchewan OC. It will also discuss the viability of the RCE Saskatchewan OC web-based platform in terms of utility (i.e. its ability to enable tasks to be completed and perceived usefulness) and usability (i.e. its ability to provide effective, comprehensible, and satisfying use). This paper is organized as follows: Section 2 will describe the structure of the RCE Saskatchewan online community and detail the steps taken in its creation. Section 3 will describe a recent preliminary survey that was completed by RCE Saskatchewan members and anonymous community members outlining the

² <http://www.saskrce.ca> (May 2009)

perceived value of the RCE Saskatchewan OC along with associated features and functionality of the technology deployed. Section 3 will also discuss results of the preliminary survey. Finally, Section 4 will provide concluding remarks and discuss directions for future activities.

2. Structure of the RCE Saskatchewan Online Community

Planning the development of the RCE Saskatchewan OC began in June of 2006. Critical to the design of the RCE Saskatchewan OC structure was the use of FLOSS-based software tools and platforms. Figure 2 illustrates the final model of development, which utilizes popular FLOSS-based software platforms associated with large user and contributor/developer communities. With the generous donation of server hardware from Luther College at the University of Regina in Regina, Saskatchewan, we were able to inexpensively build a FLOSS-based web server using the Ubuntu Server Edition (<http://www.ubuntu.com/>); a FLOSS-based server platform freely available online, the Apache Web Server (<http://httpd.apache.org/>); and MySQL Community Edition Database Server (<http://www.mysql.com/>), a limited (in terms of license), but popular FLOSS-based database server utility freely available online³. The hardware required to run a server of this type with corresponding software installed is quite minimal and inexpensive which also added value to the FLOSS-based model and the desirability for RCEs with limited financial support, especially in, but not restricted to, developing countries. Once the web server was set up, we began investigating FLOSS-based (and proprietary) software platforms to begin developing the OC backend infrastructure.

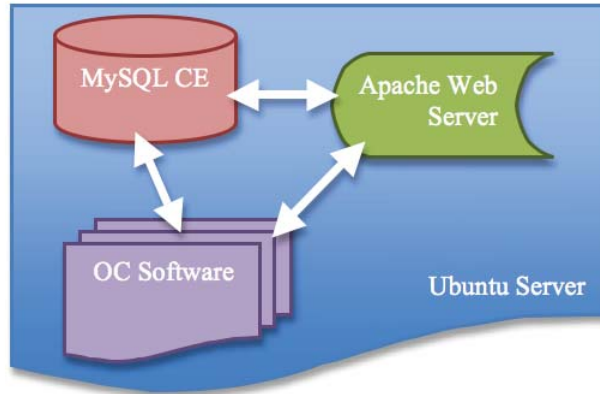


Figure 2. Illustration of the FLOSS-based server software infrastructure.

Originally, there were five underlying requirements for selection of the OC software platform. These were set out by the RCE technology group, the first working group established by the

³ With the recent purchase of Sun Microsystems (which includes the purchase of MySQL) by Oracle, a proprietary-based database company, there is some concern regarding the future of MySQL Server, Community Edition: <http://www.linux-mag.com/id/7309> (May 2009)

RCE in recognition of the importance of the OC software platform to the RCE. The following requirements were stipulated: (1) similar to the software used in the construction of the web server, the software platform to be selected in the development of the OC needed to be FLOSS-based; (2) the FLOSS platform needed to provide specific functionalities common to social networking tasks including the ability for group creation and management, file management, networking, blogging, email, wikis, and syndication; (3) the FLOSS platform had to have a visible and active community including visible communities of those who both used and who supported/built for the platform; (4) the FLOSS platform had to be capable of incorporating enhanced features into the design so as to increase the overall utility and usability incrementally over time; and finally (5) there had to be some indication of continued improvement and development of the software platform (i.e. future versioning).

2.1. Choosing the Software Platform

The first task in the development process was to survey available web-based platforms in the FLOSS (and proprietary) software community. We compared much of what we found in the FLOSS community with similar platforms in the proprietary community simply to understand the differences among the alternatives in terms of features and support, limitations and restrictions. During our survey we came across many FLOSS-based content management systems (CMSs) that seemed capable of meeting our requirements and needs without needing recourse to proprietary software. Of the many CMSs available, we chose eight specific CMSs for review, including⁴:

- (1) Joomla (<http://www.joomla.org/>)
- (2) Drupal (<http://drupal.org/>)
- (3) CivicSpace⁵ (<http://www.civicspacelabs.org/>)
- (4) Plone (<http://plone.org/>)
- (5) MODx (<http://modx.com/>)
- (6) PHPNuke (<http://phpnuke.org/>)
- (7) Xaraya (<http://www.xaraya.com/>)
- (8) Xoops (<http://www.xoops.org/>)

Of the eight CMSs reviewed, Drupal (#2 in the above list) appeared to be the most appropriate given our distinct requirements and needs. At the time of the initial development of the RCE Saskatchewan OC (September to December, 2006), Drupal was one of the more popular CMSs. At the time currently in version 4 of its development, Drupal had a very strong community of users (those who utilized Drupal for personal needs) and developers/contributors (those who actively developed Drupal and associated enhancements) which made the choice to use Drupal the most preferred. Drupal also seemed the most likely, out of the eight, to have long-term continued support and improvements. As an aside, currently Drupal is in version 6 of its

⁴ All CMS websites accessed May 2009

⁵ CivicSpace is currently available as a “plugin” comprising specific enhanced features that can be incorporated in other CMSs such as Drupal and Joomla. It is currently not available as a stand-alone CMS

development (stable) and is actively undergoing development for its next major release (which will be Drupal 7 and is expected to be released in late 2009⁶). To date, Drupal remains one of the premier CMSs of its kind (including both open source or proprietary), having a very large community of users and developers/contributors that is continually increasing.

2.2. An Initial Focus on Utility

Figure 2 illustrates the general procedure we used in the development of the OC. Figure 2 also provides an indication of the general timeline of our development process. Focusing first on the utility of the RCE Saskatchewan OC structure, we developed the original system to provide the most basic functionalities common to many popular social networking tools of the time (and currently). These features and functionalities included blogging, a forum, and the ability to comment on posted content. Although Drupal core functionalities formed the basis of the original structure of our OC (blogging being the most critical), we also incorporated enhanced Drupal features, called modules⁷, which added functionality to the core. Notably, this included the Organic Groups⁸ Drupal module that enabled the creation of group entities which were used to create Theme Area Working Group (TAWG) areas based on the six core ESD themes described previously (i.e. Climate Change; Health and Healthy Lifestyles; Farming and Local Food Production, Consumption, and Wasted Management; Reconnecting to Natural Prairie Ecosystem; Supporting and Bridging Cultures for Sustainable Living and Community Building; and Sustainable Infrastructure including Water and Energy).

After the initial release of our OC, one of the primary objectives in the design process was to include and encourage member involvement in all aspects of furthering and improving the design. Instead of maximizing the OC features and functionality out-of-the-box in order to directly understand our users' preferences in relation to these features, we choose to give our members a sense of freedom by enabling them to explore the features and functionality in their own time, testing them accordingly and providing feedback (positive or negative) when deemed necessary. In addition we allowed for non-member testing of basic functionalities through independent student testing through the Saskatchewan Institute of Applied Science and Technology, the RCE's technical institute partner. This type of incremental structure to the design of our OC was and is hoped to give our members an enriched sense of belonging as well as a sense of contribution to how the OC is structured and organized. This type of development is also hoped to encourage excitement within the RCE Saskatchewan community in the development and further refinement of the OC. Although this type of development strategy may initially hinder utility and usability in the short-term, as members may come across undesired interactions with the feature and functionality of the OC, we believe that it will have a greater impact on increasing utility and usability over the long-term of the system which, over time, enriches the overall experiences of our members.

⁶ Dries Buytaert's, creator of Drupal, blog: <http://buytaert.net/predictions-2009> (Accessed May 2009)

⁷ <http://drupal.org/project/Modules> (May 2009)

⁸ <http://drupal.org/project/og> (May 2009)

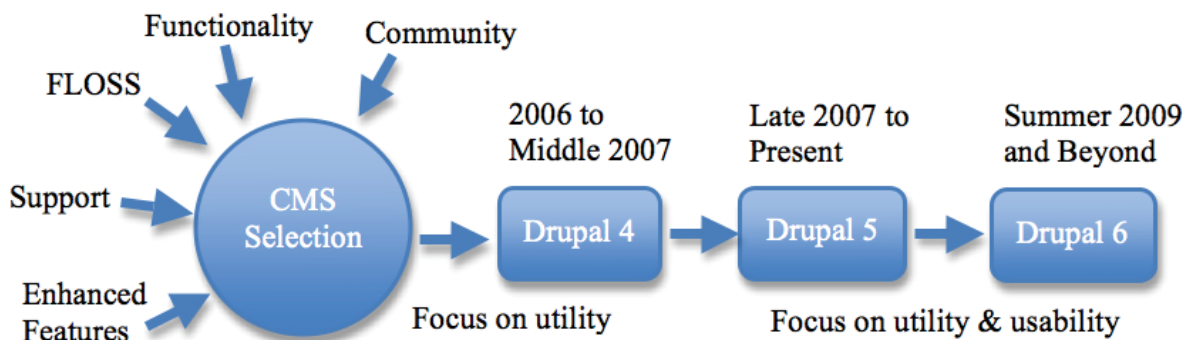


Figure 2. Illustration of our development procedure and general project timeline.

The first version of the OC was deployed in the winter of 2007 (January to April). This deployment date was needed in order to have a communications platform in time for the community celebrations of the RCE acknowledgement by the UN University in March, 2007, and the region-wide call for members occurring at this time. Shortly after, our user base (registered members and non-registered, local and non-local members) rapidly increased. Originally we adopted an open concept to the OC as we wanted to create an environment that was not hindered by restrictions or limitations. This meant we allowed both registered members and anonymous contributors to post/comment on content. Although this open model concept worked for a while, over time it proved to be idealistic as once the RCE OC gained more recognition and web presence, this increased the visibility of the OC in search engines and, as such, spamming (Kamaliha et al., 2008) became an issue. Since its initial deployment, a more strict moderation scheme needed to be incorporated into the design. This included mandatory user registration and administrative filtering of potential users to be entitled to create and post content.

In the summer of 2007 (from May to August), after the successful release of the OC and increase in member activity and equipped with a better understanding of the workings of an OC of this type, we began to investigate our options for improving and refining elements of the OC in terms of software features and functionality. As a result of member comments and our own assessment, we started investigating additional features and functionality that could be incorporated into the OC to enhance our members' experiences. As part of our investigation into new features and functionality, we deemed it a necessary first step to perform an upgrade of the Drupal back-end from Drupal version 4 to Drupal version 5. With each upgrade of the core Drupal system, new core features and functionality are included to help improve the overall utility and usability of the underlying system. As well, additional Drupal modules specific to versioning requirements become accessible as a result of upgrading.

2.3. A Focus on Needs, Utility, and Usability

Drupal 5 had been in production use since January 2007 and included many enhancements to the

design of the core system. Since Drupal 5's initial release, many bugs had been fixed accordingly and many of the popular Drupal modules, and many new modules, had been upgraded or developed to work properly with the new version. With an upgrade to Drupal 5, both the interface and core functionalities were enhanced allowing us to focus our efforts on the utility as well as the usability of our OC.

At the time of the completed upgrade to Drupal 5 (November 2007 to March 2008), the enthusiasm surrounding ESD within Saskatchewan as a result of the RCE Saskatchewan OC, and other initiatives, had been steadily increasing. It was clear that the ability of the OC to act as a portal for community members on ESD topics and enabling those within the community to keep informed and to actively contribute in the discussions had had some impact on the increased interest in ESD within our province. Although some success was indicated in our initial deployment and further refinement of our OC, we acknowledge that it is an ongoing learning process and that there was still much we and our members saw that could be improved upon in making the OC as interactively satisfying to use as possible.

To facilitate our own discussion of, and those of our community members, new features and functionalities were incorporated into the site after the upgrade to Drupal 5 which notably included:

- An events calendar highlighting upcoming events within the community
- The addition of interactive image galleries, highlighting ESD events within the region and globally including images captured of our members attending ESD conferences around the globe
- An interactive file system containing documents relevant to RCE Saskatchewan activities (unpublished documents, publications, and presentations)
- Google Analytics to gather site statics
- A WYSIWYG (What You See Is What You Get) editor to enable user-friendly posting of content in a way similar to many popular word processing suites
- A sharing feature enabling members to easily share content posted on the RCE Saskatchewan site with other popular social networking applications such as Facebook, Google, Delicious (<http://delicious.com/>), and Digg (<http://digg.com/about/>)
- A book/wiki editing tool to support members in creating book/wiki-type content (a recent feature addition to the OC based on the specific needs of some of the working groups)
- A multi-site configuration to support other ESD events in the community, specifically the 2008 RCE Conference of the Americas⁹, which brought together RCE members and practitioners from across North and South America to discuss topics on ESD, and the 2008 RCE Saskatchewan ESD Recognition Program¹⁰, which acknowledged and rewarded 28 local ESD projects and their community supporters.

In addition to these enhanced features/functionalities that were incorporated into the RCE

⁹ <http://www.saskrce.ca/conference2008/> (May 2009)

¹⁰ <http://www.saskrce.ca/RecognitionProgram/> (May 2009)

Saskatchewan OC, the user interface appearance was also updated accordingly. The update to the user interface was completed to help increase usability and stimulate additional community excitement. With all of the new features, functionality, and the changes to the interface design, we felt it important to continue to evaluate features and functionality as done in the past by soliciting comments from our OC members and by evaluating the additional features and functionality ourselves. As such, we developed and conducted a preliminary online survey shortly after the upgrade (available online between October 2008 to March 2009) to solicit user opinions on the upgraded site.

3. Preliminary Survey of Users

The online survey sample consisted of 29 participants, both members of the OC and people new to the website. Anonymity was allowed, if desired, to protect member profiles. The survey consisted of three sections comprising 20 questions. A template of the survey is available for review on the RCE Saskatchewan OC website.¹¹

3.1. Survey Responses

Of the 20 questions in the preliminary survey, we were most interested in those which provided some indication on the value of OC in terms of building capacity for ESD as well as those which indicated value in terms features and functionality.

In terms of how our participant sample rated the OC in providing value to local communities on topics on ESD, 69% of participants commented that the OC provided some value or higher. When asked a similar question whether the OC provided value to external (global) communities on topics of ESD, 66% of participants indicated the same. In terms of whether the OC provided a sense of regional belonging to ESD in the community, 79% of participants commented that the OC provided some value or higher. Finally, when asked a similar question whether the OC provided a sense of global belonging to ESD in the global community, 76% of participants indicated this was the case. In terms of developing an OC that builds capacity for ESD, these results were encouraging.

When observing participant responses on questions concerning features and functionality of the OC, we get some indication of what our community members value in terms of utility and usability. As previously mentioned, we designed the online community using social networking functionality common in many popular social networking sites, e.g. blogging, upcoming events, group pages, etc., to help stimulate excitement and promote discussion on ESD topics. In this regard, we asked participants to indicate whether they valued some of the more prominent features on the current website. One of the primary features that was highly valued by many participants was the upcoming events section (66%), in which upcoming events within the

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http://www.saskrce.ca/files/RCE_Saskatchewan_Project_Documents249/Survey_of_Web_Users_2008/rceSask-RTG-SurveyTemplate-final.pdf (June 2009)

community are highlighted. Slightly less than half of the participants (45%) indicated value in the calendar feature (complimenting the upcoming events feature), image galleries, highlighting of recent blog posts from OC members, and the TAWG homepages. Features which the participants deemed as not having significant value included the RSS (Really Simple Syndication) feature (10%), search functionality (24%), site map (17%), recent news section (35%), RCE Saskatchewan documents section (35%), and frequently asked questions (FAQ) (17%). We suspect the reason these features were rated as such was due to a lack of instruction or understanding on how to use them; the feature being incomplete, e.g. the FAQ section is not 100% developed/completed, or a lack of understanding on the intended purpose of the feature/functionality. However, further in-depth investigation is required.

In terms of content creation, over half of our participants (55%) indicated that they did not create content on the site and, thus, could not indicate ease of use. We acknowledge here, based on current posts within the OC, that many users do not create content on the site and that only a select few individuals engage in content creation. Rather, many members utilize the OC as a portal for attaining knowledge and information. Finally, in terms of rating general experiences in using the OC, over half (55%) of the participants indicated the OC was easy to use, 20% had no opinion, and 24% indicated they had some difficulty in using the site.

3.2 Discussion on Potential Improvements

We suspect improvements to the OC could be made in the form of designing a more effective navigation structure. In terms of site navigation, we utilize many Drupal defaults. In focusing our efforts on highlighting certain sections of the OC within the site's primary and secondary navigational structure (such as the location of the TAWG homepages, the RCE Saskatchewan Documents section, the FAQ, etc.), those features that are truly critical and important to building capacity for ESD based on RCE Saskatchewan's agenda) perhaps we can better enable our members to find the information they seek or that which they might wish to contribute to.

In relation to refining the navigational structure of the OC, we could also make improvements in highlighting critical features that help build capacity for ESD so as to increase and more effectively encourage participation and communication using the site features and functionality. In this respect, we could further develop the FAQ by providing interactive online tutorials that instruct and teach members on how to utilize features and functionality on the website such as how to retrieve information; how to stay connected (RSS, email, etc.), and basic information about the site, e.g. what is the purpose and agenda of the individual TAWGs, etc. This is a critical step in increasing member satisfaction as we continue to build the OC by adding new features and functionality. We must continue to teach our members how to best utilize the available tools. These online options may also need to be supplemented with periodic member workshops on site usage, as has been done from time-to-time in conjunction with RCE events.

Acknowledging that our OC is constantly evolving (incrementally) there is a continual need to explore additional features and functionality through comments made by our members based on their needs as well as what we feel may provide benefit to the OC and test accordingly. As an example of currently ongoing activities within our community, based on member comments we

have incorporated a new functionality to the OC in the form of a book/wiki-making application, which enables our OC members to collaborate on documents online. Currently we have a select few of our members utilizing and testing this functionality and we are looking forward to receiving feedback on their experiences. As well, we are currently investigating an upgrade to the Drupal back-end (from Drupal version 5 to Drupal version 6), which will, as with the previous upgrade from Drupal 4 to Drupal 5, increase utility and usability by adding new core features and functionality. The upgrade will also enable us to add Drupal 6-enabled modules, some of which are not available to Drupal 5 and are of keen interest both for us and for some of our members. As an example of the types of added features and functionality the upgrade would provide, based on member comments we currently see the need to integrate a geographical mapping suite for use by our members to map various ESD projects in our geographic region. The mapping modules under investigation are only compatible with Drupal 6, thus requiring the upgrade. This added feature will again increase interest on ESD topics within the region. It is also hoped to increase recognition, which may also increase excitement on the various projects within the RCE Saskatchewan region

4. Conclusion

In moving towards a sustainable future, ESD is a critical if not necessary element for success. OC similar to the one we currently are developing strive to help build a capacity for ESD by enabling communication and discussion without geographic limitations and restrictions. Developing such a community using FLOSS-based software and applications enables communities to quickly get started, as the relative cost in relation to proprietary software and applications is quite small. As well, in using FLOSS-based technologies, we develop a community that encourages growth and sustainability with the benefit of enriching both local and global communities through its progression. Given the diversity of users, designing truly satisfying OCs can prove challenging. However, through incremental development we ensure that we provide users with the freedom to explore and contribute to the community accordingly. This type of development seeks to provide members with a sense of belonging and contribution that they would not receive otherwise. Although it may mean that utility and usability is hindered in the short-term, long-term benefits greatly outweigh the short-term limitations. As with many other FLOSS-based applications, through community involvement and encouragement, the software application becomes more useful as time progresses as more people begin to use the application or tools and contribute to the code and community, thereby benefiting all who use it. Ongoing and future work includes upgrading the Drupal back-end to Drupal version 6, investigating a switch from MySQL (given its recent acquiring from Oracle and its unknown development future) to PostgreSQL, a complete FLOSS-based database system, and further exploring features and functionality to be incorporated into the site to help achieve complete satisfaction of use by our members.

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