African Virtual Environment Collaborative (Afro-velab)

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The over-capacity of telecommunications bandwidth in most of the world, coupled with the emergence of sophisticated workflow software has enabled business to move operations to where the talent is creating a 24 hour global enterprise. Sub-Saharan Africa (excluding South Africa), especially Science and Technology (S&T) research institutions are yet to take advantage of the immense collaborative synergies the information age has brought. This paper describes the African Virtual Environment Collaborative (AFRO-VELAB) that aims to remedy this shortfall by providing a medium where African S&T researchers can readily form research teams – based on areas of expertise – and take on sophisticated collaborative research projects that each could never attempt by going it alone.

Introduction

The twenty-first century, dubbed the information age, has seen remarkable increases in productivity and creativity, using low-cost, high-bandwidth information networks to facilitate collaboration between business units spread out across the world. No longer must business bring talent to a few central hubs located in the host country. Businesses can now tap talent at the source, using the abundance of band-width, coupled with the emergence of sophisticated work flow software to facilitate electronic and ‘face-to-face’ (via video-conferencing) communication and collaboration amongst employees in regional centres spread out across the world. The abundance of band-width, primarily in the form of fiber-optic cables, is as a result in the over-investment in capacity during the dot.com boom of the late nineties. “[Work flow software platforms], enable you to create virtual global offices – not limited by either the boundaries of your office or your country – and to access talent sitting in different parts of the world and have complete tasks that you need completed in real time. And so 24/7/365 we are all working.” (Friedman, 2006).

The main beneficiaries of this information-age spurned global collaboration have been the Americas, Europe, India, Japan, India and South-East Asia. Conspicuously absent from this new geographic boundariless world is Africa, especially sub-Saharan Africa, excluding South Africa (henceforth referred to as the region). In the region, Internet traffic, where available, primarily travels over relatively slow and expensive
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satellite connections. In the next few years however, the situation is expected to improve dramatically.

Several projects are underway that should significantly reduce the reach and cost of connectivity. For example, the 9,900 km East African Submarine Cable System (EASSy) will lay an undersea fibre optic cable from Durban South Africa to Port Sudan in Sudan, with landing points in Djibouti (Djibouti), Mogadishu (Somalia), Mombasa (Kenya), Dar-es-Salaam (Tanzania), Toliary (Madagascar), Maputo (Mozambique) and Mtunzini (S. Africa). Through land-based fibre optic cables the EASSy is to be connected to land-locked countries, Ethiopia, Uganda, Rwanda, Burundi, Malawi, Zambia, Zimbabwe, Botswana, Swaziland and Lesotho. Leading Telcom operator MTN Uganda’s strategic planning general manager, estimates that as a result of the cable project, “The cost of transmitting telcom traffic [in the region] will come down by 80 per cent” (Barigaba, 2006).

The business community in the region will undoubtedly take advantage of the potential improved connectivity brings. What of the regions science and technology (S&T) research institutions? Will they be left on the sidelines? This paper argues that improved connectivity, coupled with appropriate work flow software with embedded information systems will give researchers in African Science and Technology institutions a level playing field and new opportunities for excellence, similar to the lifeline these innovations gave software programmers in Bangalore, India.

The Africa Virtual Environment Collaborative (AFRO-VELAB) hopes to capitalize on the inevitable improved connectivity in the region to significantly foster collaboration amongst African S&T researchers, primarily, and between them and researchers in the rest of the world. It will foster the creation of synergies between the regions researchers, allowing them to attract research funds, and to make significant contributions to the knowledge-base relevant to Africa’s problems, in a way that none of them could if they went it alone.

**Contextual Example: Research On Attractant-bait Mosquito Traps Relevant To Africa**

**Introduction.**

Malaria continues to be a major public health problem in much of sub-Saharan Africa. Ogot (2004) discussed potential research areas, relevant to Africa, for the further development of attractant-baited traps as a viable avenue for the reduction of adult mosquito populations, and made a presentation on the challenges to forming viable research teams in this regard. Attractant-baited mosquito traps, first introduced in the United States for widespread consumer use in the mid-1990s, have the potential to provide an environmentally friendly alternative to insecticide use for the control of adult mosquito populations. Although several variations exist, all work around the same basic principles. Mosquitoes are attracted to their mammalian hosts by detection of carbon dioxide (CO₂), water vapour (H₂O) and other odors that mammals exhale, in addition to body heat. With reference to Figure 1, mosquito traps produce these mammalian attractants to lure the mosquito towards them.
Representative Products and their Applicability to Africa. Consider the Mosquito Magnet® (illustrated in Figure 2) produced in the US that runs off propane and electricity. With reference to Figure 3, three of the mosquito attractants (carbon dioxide, water vapor and heat) are produced from the controlled combustion of propane gas that is readily available as liquid propane gas (LPG) in tanks. The trap also has an electric fan, placed near the exit area of the attractants from the trap, that sucks in the unsuspecting mosquitoes into a net where they die from dehydration. Some models use a thermal electric generator to convert the excess heat produced from propane combustion into electricity, thereby eliminating the need for an external electricity source. Other models also release 1-Octen-3-ol, a natural flying insect attractant (Ramoni, 2001) that has been shown to increase the attractiveness of mosquito traps by several orders of magnitude (Kline, 2002).
With reference to the functional breakdown diagram in Figure 3, the manner in which two functional areas (attract production and mosquito trapping mechanism) of this trap is manifested would prevent its wide use in sub-Saharan Africa, especially rural areas. Specifically

1. The traps require the purchase of a 9 Kg propane tank after every 20 days of continuous operation. This cost, not to mention the initial invest of these traps, would be beyond the financial means of most of the target population.

2. Most rural areas do not have a regular supply of electricity. Some traps use a sticky tape as an alternative to the electric fans. This may present a suitable option for the African-context.

Potential Research Areas. Research continues in the developed world to design the next generations of mosquito traps that are more effective in significantly reducing adult mosquito populations, than those on the market today. These efforts, however, are all within the context of the developed world especially as relates to the purchasing ability of the end-user and their available resources. In order for these devices to be applicable for use in Africa, Africans must initiate research in areas that make the traps relevant for use in their context. Example areas include (Figure 4):
1. Development of attractant production methods that use locally available resources. For example, the use of biogas – produced within the trap itself – may be a viable replacement for propane. Biogas can be produced by anaerobic digestion of animal waste and consists primarily of methane (50%-80%), carbon dioxide (20%-50%). Two of the desired attractants, carbon dioxide and heat, are produced by the anaerobic digestion process. Novel methods need to be developed to effectively use these attractants as well as those produced from methane combustion.

2. Develop trapping mechanisms that do not require the use of electricity. Creation of sticky surfaces from local materials has potential, as does design of systems that can develop suction without the use of fans – for example the use of the convection currents from the combustion process.

3. As much of the trap itself as possible should be constructed from locally available materials. Costs can further be reduced if the end-user is able to construct/assemble the traps from a combination of a very small number of inexpensive purchased parts and other components that can be found around a typical homestead.

If one wanted to put together a team of researchers from the region to tackle the above problem and develop a viable device, how would one do it? Information on the research capabilities and interests of the region’s S&T researchers is virtual non-existent on the Internet in a manner that is readily searchable. For example, if one was searching for the region’s leading researchers on bio-gas, one would have to follow a circuitous route: Search relevant journals for bio-gas research articles; screen articles found for
relevant bio-gas research areas of interest to you; screen sub-set of articles for regional scientists; contact scientist. Not a simple task. Yet, as this example shows, the need for Africa-based scientists, as part of the research team, would be imperative due to their extensive knowledge of local materials and conditions. Finally, even if a team could be formed, how would it effectively work together given the limited budgets of most sub-Saharan institutions, not to mention the significant time-wasted travelling?

AFRO-VELAB aims to harness the power afforded by modern information-embedded work flow software coupled with improving connectivity in the region to address these problems.

AFRO-VELAB

Genesis: The Africa Virtual Environment Collaborative (AFRO-VELAB) project originated during discussions at the “Collaboration of Researchers at African S&T Institutions and African Scientists in the Diaspora” workshop held at the 1st ANSTI Conference of Vice-Chancellors, Provosts, and Deans of Science in Engineering and Technology held in Accra, Ghana from 15-17 November 2005. At the workshop several impediments to effective collaboration were identified, that it was hoped AFRO-VELAB would address. These include (Ogot, 2005):

1. Lack of access to academic journals.
2. A serious lack of information about sister institutions on the continent. Need for better leverage of resources that exist on the continent.
3. Most current assistance/collaborations from overseas does not target engineering. Health, gender issues, and social sciences have thriving collaborations. An opportunity currently exists to establish collaborations for engineering.
4. All collaborations must be mutually beneficial and conceived by both parties to ensure success.
5. One should not assume that all researchers in the region or the Diaspora are willing to or are seeking collaboration. Effective collaborations must be of the willing, not the coerced.
6. Collaborations should not be restricted to S&T universities only. Significant research is carried out at government and donor-sponsored research centres within African countries, e.g. ICIPE, ILRAD, etc.
7. Scientists seeking collaborations must be proactive and not wait for things to come to them.
8. Collaborative projects should be directed at ‘Research for Development’ to enhance the impact of African universities on the development of African rural societies.

The AFRO-VELAB, therefore, is being developed in response to the above, and the current difficulty in identifying researchers and research capabilities at Africa’s S&T institutions. Such a system would greatly increase the visibility of African researchers and significantly increase intra- and inter-continent collaboration. Specifically, the secure virtual collaborative would be used to:
1. Rapidly form research teams through its database of African/Diaspora researchers (categorized by area of expertise) seeking collaboration. The database would include both university and government laboratory researchers.

2. Generate multi-institutional cross-disciplinary research proposals in response to Request for Proposals.

3. Provide an online collaborative environment to carry out research across geographic boundaries. The environment would also provide an efficient means to share information and to collectively work on documents (more efficient and better tracking than email attachments).

4. Keep projects on schedule by incorporating project management tools. The system would include major languages used by S&T institutions in Africa: English, French, Arabic and Portuguese.

**Overview Of Afro-velab**

The following sections will present mock-up screens of Phase I of the proposed system to give an indication of its capabilities.

*Secure Environment.* All users would need to be registered and be required to login (Figure 5). Registration and user accounts will be through member institutions or directly with AFRO-VELAB. At the time of registration, contact information, research interests, etc will be collected and categorized.

**Figure 5. Login Page**
Research Groups and Projects. Users can belong to as many research groups as they like. Once logged in, all active research groups that the user is a member of are visible on the left, categorized by research projects (Figure 6). Also available is a list of tools available. These include email, a list of tasks (to do list), a calendar, etc.

Creating a New Research Group. As earlier alluded to, the largest perceived benefit of AFRO-VELAB lies in using the embedded information systems to rapidly put together research groups in response to a call for proposals on a particular research area. The system addresses one of the greatest challenges for collaborative research in Africa: access to information on research interests of different scientists and engineers at the multitude of science and technology research institutions on the continent. With reference to Figure 7, one can search for a researcher via a series of pull down menus that categorize scientists first by general researcher areas, then more specific later on.

Once the desired research area is selected, all scientists in the system under that area and their current affiliation are listed (Figure 8). Selection of one of them, David Otieno in this example, brings up the researcher’s contact information, research areas and current Curriculum Vitae. One then has the option to contact the researcher to see if they are interested in participating, and if so, add them to your group. All group information and documents (similar to Figure 6) immediately become visible to the new group member.
Figure 7. Pull-down menus used to search for a scientist with a desired research interest

Figure 8. List of researchers in desired area and detailed information available if one selected

Figure 9. Clicking on a group lists all available documents as well as tools available to the project
Workflow Tools. Once groups have been formed and research initiated, AFRO-VELAB provides workflow tools that allows the sharing of documents, discussion groups, team calendar and tasks lists, as well as project management tools (see Figures 9 and 10).

**Charting The WAY Forward**

Dr. Ogot is currently leading the initiative to develop AFRO-VELAB as a vehicle to facilitate active collaboration amongst researchers in Africa’s S&T institutions, and between continent researchers and those in the Diaspora in research institutions outside the continent.

Development and Beta-Testing of the System (2 years). Working closely with the working group, partners – including the ANSTI, Association of African Universities (AAU), Western Hemisphere Diaspora Network (WAHDN) – and based at the Pennsylvania State University, efforts are underway in the development of the system. Beta-testing will follow shortly thereafter at the 10 working partner institutions listed in Table 1. Other institutions are welcome to serve as beta-testers as well as lend their expertise in the development of the system.

In parallel, development of training programs and training materials will proceed. It is envisioned that we will train trainers at each of the partner institutions. The trainers will then be responsible for all training of new users at their institutions. During the beta-testing work will begin in populating the system’s database with researchers seeking collaboration, their research interests and current contact information. This data will be gathered during the each user’s registration process. The system will also be configured to automatically issue a reminder to users on a semi-annual basis, to update their contact information. Initial seed funding for the development phase of the system has been sought from several developmental and science agencies (e.g., US NSF, EU, Canadian IDRC) and from commercial companies. We view the long term sustainability for the system may use a combination of subscriptions from participating universities and research institutions, combined with development grants from governmental agencies, private foundations and commercial companies.
Table 1. Initial Beta-Testing Institutions

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<th>Institution</th>
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<tr>
<td>Faculty of Engineering and Technology, University of Botswana</td>
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<tr>
<td>University of Port Harcourt, Nigeria</td>
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<tr>
<td>Ecole Nationale Supérieure des Travaux Publics, Cameroon</td>
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<tr>
<td>University of Benin, Nigeria</td>
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<tr>
<td>Faculty of Engineering and the Built Environment, University of Johannesburg, SA</td>
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<tr>
<td>Obafemi Awolo University – Main campus, Nigeria</td>
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<tr>
<td>University of Buea, Cameroon</td>
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<tr>
<td>Howard College Campus, University of Kwazulu-Natal, S. Africa</td>
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<tr>
<td>University of Nairobi, Kenya</td>
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<td>Moi University, Kenya</td>
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<tr>
<td>University of Kwazulu-Natal, S. Africa</td>
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Full Deployment (Year 3+). Once beta-testing is complete, there will be active recruitment of participating institutions on the continent and internationally. As with the beta-testers, a series of training of trainer sessions will be held at each newly added institution. The system will also be ported from Penn State University computer systems to a commercial hosting company in anticipation of the need for significant increase in capacity and bandwidth due to higher use. In addition, we aim to shift base of operations from Penn State University to Nairobi, Kenya where ANSTI is based.

The addition of features will follow soon thereafter including other languages used in Africa’s S&T institutions, mainly French, Portuguese, and Arabic; global research and notification of relevant research opportunities; and in close collaboration with African universities, development, hosting and deployment of remotely-controlled over the Internet educational laboratories that can be used by all institutions to mitigate their lack of adequate undergraduate educational infrastructure.

Other additions to the system could include provision of web-based science and mathematics software, digitization and hosting of all Masters Thesis and Dissertations, in addition to proceedings from regional technical conferences.

Concluding Remarks

Sub-Saharan African S&T institutions have lagged behind their western counter-parts for decades mainly due to lack of adequate funding and access to current information. The information age has given the region’s researchers the opportunity to leverage the capabilities of information-based work flow software and improved connectivity, to create synergies amongst each other that can foster significant collaboration allowing them to play a larger role on the world S&T stage, especially as pertains to solutions to problems relevant to the continent. The AFRO-VELAB, a work-in-progress, is
hopefully a step in that direction. By creating an enabling environment, researchers can spend more time working on solving Africa’s problems, and less on ‘re-inventing the wheel’ due to lack of information about work on-going at sister institutions or experience frustration at their inability to effectively collaborate with each other, forming teams to compete for large international research grants. We welcome any institutions, organizations or individuals willing to participate in the development and deployment of the system.

References


