canarie

Canada's Advanced Research and Innovation Network
Le réseau évolué de recherche et d'innovation du Canada

# Network-Enabled Platforms (NEP-2) Program

# Final Report

*Project Information*

| Lead Contractor: | McGill University | | |
|---|---|---|---|
| Project Name: | Open Orchestra | Project #: | NEP-54 |
| Date: | January 31, 2012. | | |
| Period: | October 1, 2009 | To: | December 31, 2011. |

## 1.0    Project Objectives

## 1.1    Phase Deliverables

*Please, enumerate the technical objectives or deliverables for each phase of the project as described in the Project Agreement in the table below. Please describe the actual achievement for each phase in terms of the deliverables (original or as amended). Please include a description of any deliverables that were added during the project.*

*Also, please provide a rating of the degree to which each objective or deliverable was actually achieved. Using a scale of 1 – 5, with 1 indicating not at all, and 5 completely, rate the degree to which the project achieved the objectives for each phase.*

| Objective/Deliverable | Actual Achievement | Objective Achievement Rating (1-5) |
|---|---|---|
| **Initial** | | |
| Hire team | Complete | 5 |
| Determine project scope | Complete | 5 |
| **Data Acquisition** | | |
| Plan digital orchestration | Complete | 5 |
| Initial video and audio acquisition plan | Complete | 5 |
| Test video and audio acquisition | Complete | 5 |
| Test voice acquisition | Complete | 5 |
| Test video and audio playback | Complete | 5 |
| Revised video and audio acquisition plan | Complete | 5 |
| Record video and audio for software development | Complete | 5 |
| **Added:** Record three series of recordings instead of one: jazz, classical and opera | Complete | 5 |
| **Added:** Record moving camera opera as well as static camera opera | Complete | 5 |
| Edit video and audio | Complete | 5 |
| Implement video & audio conversion for simplified mode | Complete (jazz only as planned) | 5 |
| **Software/User Interface Requirements** | | |
| Draft preliminary software & database specifications | Complete | 5 |
| Install test server | Complete | 5 |
| Develop prototype multiple track player | Complete although with occasional video glitches | 4 |
| Develop track synchronization adjustment if necessary | Complete although with occasional sync glitches | 4 |
| Develop method of storing and playing score with overlay | Complete | 5 |
| Develop performance record function | Complete | 5 |
| Develop audio mixing console | Complete | 5 |
| Develop audio editor | Abandoned due to user group input that it is not required. | 1 |
| Develop selective playback function | Complete | 5 |
| Develop expert performance evaluation function | Complete as standalone program | 4 |
| Test database under load | Complete | 5 |
| Develop audio comment function | Complete | 5 |
| Develop written comment on score function | Abandoned because touchscreen doesn't allow it. | 1 |
| Develop user workspace | Complete | 5 |
| Develop instructor workspace with download function | Complete | 5 |
| Develop simplified mode for home use | Complete | 5 |
| Modify system based on test results | Partially complete; testing continues | 3 |
| Document system and prepare user instructions | Complete | 5 |

| User Formal Evaluation | | |
|---|---|---|
| Prototype multiple track player | Complete | 5 |
| Playing of score with overlay | Complete | 5 |
| Record function | Complete | 5 |
| Audio mixing console | Complete | 5 |
| Audio editor | Abandoned due to user group input that it is not required. | 1 |
| Performance evaluation function | Not complete; testing continues | 1 |
| Comments functions | Partially complete; testing continues | 3 |
| User and instructor workspaces | Partially complete; testing continues | 3 |
| Final system | Partially complete; testing continues | 3 |
| Simplified version | Not complete; testing continues | 1 |
| **Demonstrations** | | |
| Player/recorder for CANARIE staff | Complete | 5 |
| Audio mixing console for CANARIE staff | Complete | 5 |
| CANARIE workshop | Complete at Canada 3.0 Conference | 5 |
| BCnet conference | Complete | 5 |
| Final system for CANARIE staff | Complete | 5 |
| Press demonstration | Not complete | 1 |
| RISQ conference | Complete substituting International Distance Learning Conference | 5 |
| International Conference | Complete at AES San Diego Conference | 5 |

## 1.2    Overall Objectives

*Please provide an overall rating of the degree to which the project met its objectives. Use a similar rating of 1 – 5, as above.*

Rating: 5
Please explain.
Although user testing and work on eliminating the occasional video glitches continues, the project met almost all of its objectives and went beyond them by producing three sets of recordings (jazz, classical and opera) instead of the one set originally planned. It also introduced a moving camera version of the opera in addition to the static camera version.

### 1.3 Project Contribution to CANARIE Objectives

*Using a rating of 1 – 5, as above, please rate the contribution of your project to objectives for the program that are consistent with the objectives of CANARIE's funding…*

1. *To accelerate development and implementation of research platforms.*

   Rating: 5
   Please explain and provide examples.
   The project introduced the concept of a research platform in the performing arts which should encourage expansion of research platforms into new fields. It is also pioneering the streaming of multiple simultaneous streams of high definition video and audio for research and training platforms.

2. *To facilitate development of associated virtual organizations.*

   Rating: 4
   Please explain and provide the number of registered users that are using your platform.
   Most importantly, the project has created a new virtual organization for training in music performance. Since the project is in the proof of concept and initial testing phase, the platform has only been made available to the five partner institutions that are doing the testing. Within these institutions, there are 15 researchers using the platform. They in turn have been using the platform with approximately 30 students during the testing.

3. *To increase international connectedness of Canadian platforms.*

   Rating: 1
   Please explain and specify what international connections were achieved.
   Although there has been international interest in the project through presentations made at international conferences, use of the platform in other countries will not be implemented until testing in Canada has been completed.

4. *To advance the use of platforms by Canada's researchers.*

   Rating: 5
   Please explain.
   The research group involved in the project is one of the few that has been working to create the very realistic experience of being in another environment with the ability to interact with the people and equipment there. The next generation platform being developed by the project can be applied in many other areas.

5. *To promote sharing of best practices and standards re: next-generation technologies (e.g. SOA-based middleware).*

   Rating: 3
   Please explain and provide examples.
   The project has developed numerous best practices and standards in the use of immersive simulations for performance training, particularly for intuitive user interfaces. These will be shared with similar new platforms as they emerge.

However sharing is obviously limited at present since this is the first such platform.

6. *On a scale of 1 – 5, with 1 being not at all, and 5 being completely, please rate the extent to which this project contributes to the achievement of the overall CANARIE objectives.*

Rating: 4
Please explain.
As a new type of platform, the project is limited in its ability to share middleware with others and to expand domestically and internationally before initial testing is completed. However it meets all of the other CANARIE objectives fully.

## 1.4   Connection to CANARIE network

*If your project used a Light path, please explain the advantages and benefits.*

*If you were not connected to the CANARIE network using a Light path and alternatively used a shared connection, can you estimate the cost of the shared connection?*

This project would not be possible without the CANARIE network. The immersive experience uses three simultaneous streams of high definition video plus multichannel audio that requires a very high bandwidth network to transmit this amount of data.

The project does not use Light paths. The five partner institutions are connected to the CANARIE network using existing facilities and have not had additional ongoing connection costs. There was a one-time cost of $3,500 at the University of British Columbia to replace an obsolete locally located switch that was unable to handle the high bandwidth video efficiently.

## 2.0   Information Dissemination/Awareness Campaign

*Please describe initiatives to disseminate the knowledge gained or technology developed during the project to the broader community. This will include conference and workshop presentations, scientific publications and other electronic media communications.  Please identify the audience being reached. (T - technical, B - business, S – Industrial Sector, E – Education Sector, H – Health Sector, P – other public sector, M -Mixed, O – other, please describe).  Please complete the following summary tables and provide complementary narrative discussions.*

### 2.1 Conference/Workshop

*For the first table, list all conferences and workshops at which presentations related to the project were made. Identify the category of the initiative (CS – CANARIE sponsored conference, NC – non CANARIE sponsored conference, PS – project sponsored workshop/seminar, OW – other workshop/seminar, OT – other, please describe) and number of attendees (indicate if an estimate). Also describe the audience being reached, using the categories described above.*

| Conference/ Workshop/Seminar | Category | Registration Fee (Y/N) | Number attending | Audience |
|---|---|---|---|---|
| BCnet 2011 Annual Conference | CS & NC | Yes | ~200 | Western Canada |
| Canada 3.0 Conference | CS & NC | Yes | ~1,800 | Canada |
| International Symposium on Synchronous Distance Learning (virtual conference - 15 sites) | NC | No | ~200 on line | International |
| Audio Engineering Society Conference, San Diego | NC | Yes | ~100 | International |

### 2.2 Publications

*Please list publications resulting from the project, and identify the type of audience being reached.*

| Article title and location | Audience |
|---|---|
| "A High-Fidelity Orchestra Simulator for Individual Musicians' Practice," Computer Music Journal, forthcoming 2012. | International |

### 2.3 Print and Electronic Media (Promotion/Communication)

*Please describe print and electronic media reports and events in which the project has been promoted or communicated, and identify the audience being reached.*

| Title/event | Audience |
|---|---|
| Johnson, L., Adams, S., and Cummins, M. (2012), The *NMC Horizon Report: 2012 Higher Education Edition.* Austin, Texas: The New Media Consortium, p.20. | International |
| "Open Orchestra Project," *UBC High Notes Fall 2011*, p. 19. | Canada |
| "Partner with national and international arts and education institutions to create unique, multidisciplinary performances and projects," *National Arts Centre Annual Report 2010 – 2011*, p. 19. | Canada |

## 3.0    Project Final Status

| Project Final Status | Print X if True |
|---|---|
| Project cancelled before completion | |
| Project incomplete | |
| Proof of concept completed | X |
| Developed regulations, standards | X |
| Technology development not yet completed (no agreement on further work) | |
| Technology development not yet completed (work continuing) | X |
| Technology development completed | |
| Product/service development not yet completed (no agreement on further work) | |
| Product/service development not yet completed (work continuing) | X |
| Product/service agreement completed | |
| Other (please describe) | |

## 4.0    Sustainability/Commercialization

*What are the next steps for your research following the completion of the project as defined in the Project Agreement?*

The project has received maintenance funding from CANARIE for the period January 1 to March 31, 2012. This will enable completion of the technology development and more extensive user testing at the five partner institutions.

If the technology development and user testing are completed successfully then the commercialization phase will begin.

*Can you briefly describe your sustainability plan related to this project.*

The platform can be further developed and commercialized for music performance training and/or adapted for other training applications.

There are two versions of the platform: the three screen immersive workstation and the single screen non-immersive home computer version. Both versions will require additional funding to make more recordings to increase their usefulness. While commercialization of the home version could conceivably be done in-house or by a spin-off SME, the workstation version will require large corporate partners. Once the platform is functioning smoothly, we will be able to approach potential corporate partners and provide them with hands-on demonstrations. Commercialization of the workstation version includes development and marketing of both the software and the recordings. The hardware workstations will presumably continue to be produced by Melnik Resources Ltd. in Ontario.

Whatever happens with the commercialization of the music performance training platforms, there is the possibility of adapting the workstation version to create immersive environments for use in other training applications and for the remote operation of equipment in hostile environments.

*If you have not established commercialization of your project then please complete the table below:*

| Project Commercialization/Application Status | Print X if True |
|---|---|
| No plans to apply project results | |
| Potential utilization of project results within partner organization(s) being studied | X |
| Project results being utilized within partner organization(s) | |
| Project results commercialization on hold pending review/market study | X |
| Commercialization on hold pending search for partners | X |
| Commercialization in progress by project participants | |
| Commercialization in progress with new partners | |
| Application on hold pending search for partners | |
| Application in progress by project participants | |
| Application in progress with new partners | |
| Product/technology licenced | |
| Open Source software supported | |
| Other (please describe) | |

*If you have established commercialization of your project, please describe any commercialization activities that were undertaken during the development of the project including immediate and anticipated results. Also provide a summary of the activities that are planned to continue commercialization/adoption of the solution by the targeted communities.*

### 5.0    Socio-economic Impacts

#### Beneficiaries
*Who are the intended beneficiaries (beyond the participants) of this project? (private sector, government, public) Please describe and provide examples of the sector(s) the project is designed to support?*

The project directly benefits those involved in music performance training which includes both the public and private educational sectors, but also the general public who can benefit from the home version of the system. Adaptation of the basic immersive environment concept to other training domains can benefit the corporate sector.

#### Intended Impacts
*What benefits is the project designed to provide to the beneficiaries? (social, economic, improved efficiency, quality of life, health, education, R & D) Please provide a short description.*

The music performers benefit from the greatly increased opportunity to perform with an orchestra or ensemble. The public and private educational sectors benefit from the major reduction in the cost of instructional personnel, facilities and logistical support. Adaptation to other training domains such as the remote operation of equipment in hostile environments reduces both costs and safety hazards.

### Actual Impacts

*To what extent are the target beneficiaries now receiving the intended benefits? (Project not yet at that stage; some early benefits (describe); benefits flowing to target community – describe).*

The project is still in the testing phase and is not yet at the stage where it is delivering the intended benefits beyond the five institutions involved in the testing.

*If applicable, please describe any new development opportunities or projects generated by the current project.*

The McGill team's work on this project gave it the experience necessary to lead the Canada-California Strategic Innovation Partnership (CCSIP) project, involving six Canadian and five California universities, to explore the possibility of forming an international research consortium in Digitally Merged Environments where one can have the very real experience of being in and interacting with a remote environment. The project's report was submitted in 2010.

### Contribution to Innovation

*Please provide examples of how this project contributed to innovation among the intended beneficiaries and/or the targeted sector?*

The project has generated considerable interest in the educational technology sector as an example of where it will be heading over the next two to three years. *The NMC Horizon Report 2012,* referred to in section 2.3 above, highlights game-based learning as one of the emerging educational technologies with a major "potential impact on teaching, learning, and creative inquiry within the higher education environment." It then describes this project as an example of leading edge innovation in this area.

*If applicable, please describe any discoveries made or lessons learned from the project team or users' point of view?*

The project demonstrated that the concept works in practice. In initial testing, 83% of students agreed or strongly agreed that, "This system had a positive impact on my learning," while 100% agreed or strongly agreed that, "I would use this system again."

We initially under-estimated the expertise required to build the camera rig, lacking such expertise ourselves, and thought that it was a fairly simple matter. After several months of delay, we sub-contracted the work to Melnik Resources Ltd. and were glad we did.

New systems for the transmission and display of high bandwidth video often give sub-optimal initial results suggesting a bottleneck in the data flow. Several times the programmers have suggested that the bottleneck must be in the CANARIE network when in fact it has always been found to lie elsewhere.

*R & D as part of strategic business culture*
*How valuable is network based collaboration for your organization? Following this R & D experience, do you feel there is an increasing focus of your R & D on network based collaboration and how would you demonstrate this.*

Although we have had a number of previous projects involving network collaboration, these have always involved only two sites. This was our first project involving as many as five sites. When the problems with the transmission and display of high bandwidth video arose, it was invaluable to be able to test the same procedures with different sites to determine whether the problem could be replicated at all the sites or was really a local issue at one site.

The project is a major initiative of McGill's Centre for Interdisciplinary Research in Music, Media and Technology (CIRMMT) and makes an important contribution to its ability to attract outside funding for its ongoing operations. The Centre will definitely be increasing its focus on network based collaboration.

## 6.0 Role of CANARIE

*Please provide a rating for the following statements that focus on the role of CANARIE in this project. Use a scale of 1 – 5, where 1 is not at all and 5 is to a great extent).*

| Role of CANARIE | Rating (1-5) |
|---|---|
| CANARIE staff provided valuable support to the project | 5 |
| CANARIE helped improve the original Expression of Interest/Project Proposal | 5 |
| CANARIE support during the project contributed to project success | 5 |
| CANARIE support contributed to improved collaboration among the partners | 5 |
| CANARIE support contributed to improved project management skills | 5 |
| Other (please describe) | |

*Please comment on CANARIE's current Project Management Process using a scale of 1 – 5 as in the table above:*

| CANARIE Project Management Process | Rating (1-5) |
|---|---|
| Call for Proposal Process | 4 |
| Project Evaluation and Shortlist Process | 5 |
| Site Visit and Technical Review Process | 5 |
| Claim and Reimbursement Process | 5 |
| Project Closure Process | 5 |

*What additional role could CANARIE have provided to support the successful completion of your project?*

The Call for Proposal Process required a Statement of Work with a detailed description of the proposed software technology architecture and database structure. This necessitated several weeks of work and 24 pages with many diagrams to explain before any funding was available. A much shorter summary with an example or two should have been sufficient to judge the competence of the applicants to undertake the work being proposed. With that sole exception, the Project Management Process and support provided by CANARIE staff were superb.

## 7.0 Economic Impact

*What economic value will your project deliver including job creation, intellectual property creation, development of highly qualified personnel, and impact on research productivity? Please provide examples.*

The project created four full time positions and fifteen part time positions. It is also provided HQP training for graduate students in Engineering and Music.

The two camera rigs and five workstations were built by Melnik Resources Ltd. in Mount Brydges, Ontario which benefitted not only economically, but through acquisition of design expertise in this specialized area.

The administrative and technical staff of McGill's Centre for Interdisciplinary Research in Music, Media and Technology (CIRMMT) gained additional expertise and the project enabled the Centre to showcase its research productivity and helped it obtain additional operating funding.

*Did this project help Canada establish itself as a leader in research networking?*

The Horizon Project rates leading edge international educational technology projects on their "relevance" and "interestingness." Our project received the maximum 5 points out of 5 in both categories. As mentioned earlier, it also cited the project in its *Horizon Report 2012.*

*How many researchers in Canada and/or Globally did you collaborate with during the execution of your project and can you provide the names of those individuals and the organizations they represent?*

Steve Bellamy, Humber College Institute of Technology & Advanced Learning
Dwight Bennett, University of British Columbia
Denny Christianson, Humber College Institute of Technology & Advanced Learning
Mark Fewer, McGill University
Gordon Foote, McGill University
Nancy Hermiston, University of British Columbia
Hank Knox, McGill University
Theresa Leonard, The Banff Centre
Douglas McNabney, McGill University
Maurizio Ortolani, National Arts Centre Orchestra

Chris Segnitz, The Banff Centre
Barbara Smith, National Youth Orchestra of Canada
Fred Stride, University of British Columbia
Pace Sturdevant, National Arts Centre Orchestra
Mark Zuberbuhler, University of British Columbia