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MEMORANDUM

ATTENTION Senate
FROM Jon Driver, Vice-President, Academic and
Provost, and Chair, SCUP
RE: Full Program Proposal for a Graduate Certificate in Modelling of Complex Social Systems (SCUP 09-46)

DATE October 13, 2009
PAGES 1/1

At its October 7, 2009 meeting SCUP reviewed and approved the full program proposal for a Graduate Certificate in Modelling of Complex Social Systems.

Motion

That Senate approve and recommend to the Board of Governors, the proposal for a Graduate Certificate in Modelling of Complex Social Systems.

encl.

c: W. Parkhouse

MEMO

Dean of
Graduate Studies

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TO Senate Committee on University Priorities

TEL

FROM Wade Parkhouse, Dean, Graduate Studies

RE Faculty Applied Sciences: Graduate Certificate in Modelling
of Complex Social Systems (MoCSSy) [GS2009.18]

CC F. Popowich

DATE September 9, 2009

At its meeting of 13 July 2009, SGSC approved the proposal for a graduate
certificate in Modelling of Complex Social Systems (MoCSSy) and is
recommending it to SCUP. [GS2009.18]

**Proposal for a
GRADUATE CERTIFICATE
in
MODELLING OF COMPLEX SOCIAL SYSTEMS
at
Simon Fraser University**

1 EXECUTIVE SUMMARY

In July of 2008, Simon Fraser University approved the CTEF proposal entitled “Modelling of Complex Social Systems” thereby providing funding and university buy-in to the program. The MoCSSy program brings together researchers with extensive expertise in criminology, health sciences, urban dynamics, computing science, and mathematical modelling, under the unifying theme of modelling the complex dynamics that drive the linked epidemiologies of crime, disease, homelessness and other social ills in urban neighborhoods. The program’s long-term goals are to:

- **Generate a modelling and visualization toolset that will be applied to elevate the knowledge and understanding of urban complex systems to an unprecedented level.**
- **Develop a new generation of researchers who understand the complex dynamics of urban systems.**

In order to meet the second goal of the program, and in order to support the strategic goals of the University (such as strategic investment in health, computation, safety, security, criminal behaviour, and infectious diseases), we propose the creation of a Graduate Certificate in Modelling of Complex Social Systems. This Certificate Program will recognize individual achievement in the interdisciplinary study of Modelling of Complex Social Systems, providing them with proof of a stronger graduate degree.

2 PREAMBLE

Many of the social issues of the 21st century are captured in the studies of criminology (crime, safety, security, privacy), health sciences (harm reduction, disease spread, mental health, tractable public health care), and urban dynamics (homelessness, unemployment). Research into these areas will have a profound impact on the quality of life for everyone by reducing crime, reducing harm and addiction, enhancing safety and security while maintaining privacy, and improving health and welfare. In the past, much of the quantitative research in these areas focused on applying statistical techniques to determine relationships. Although these studies provide great insight into these issues, they are limited in their ability to model the complicated dynamics that arise from the overlap between social issues, the spatiotemporal nature of social systems, and the dynamic nature of social interactions. Furthermore, previous techniques have been limited in their ability to predict the impact of various policy decisions. Simon Fraser University is in a position to take a leading role nationally and internationally in the development of an innovative research and training program that examines how these

challenges can be understood and addressed through mathematical and computational modelling.

The MoCSSy program brings together researchers with extensive expertise in criminology, health sciences, urban dynamics, computing science, and mathematical modelling. The unifying theme of this project is the modelling of the complex dynamics that drive the linked epidemiologies of crime, disease, homelessness and other social ills in urban neighborhoods. This group has secured CTEF funding which demonstrates university support and provides the chance to create a program that will attract and train a new generation of researchers who will understand the complex dynamics of urban systems. To that end,

we propose the creation of a Graduate Certificate in Modelling of Complex Social Systems.

This novel, interdisciplinary graduate certificate is anticipated to attract high quality graduate students to SFU, enhancing SFU's role both nationally and internationally in the Modelling of Complex Social Systems.

3 PURPOSE OF GRADUATE CERTIFICATE

The Graduate Certificate will provide students an opportunity to learn within the framework of a novel interdisciplinary program that will enhance their achievement and encourage collaborative and integrative approaches to research of national importance. By providing formal recognition of the MoCSSy students' accomplishments, SFU will increase the students' academic potential and mobility.

3.1 Increased Academic Potential

The MoCSSy program represents a new and rapidly growing field of research. Students with interdisciplinary training will be in the position to apply for a greater variety of jobs, and have a stronger academic background to support them. Students in the MoCSSy program will be encouraged to publish in high quality journals, and to participate and present research results at international conferences. MoCSSy hosted events will bring internationally renowned researchers to SFU and introduce them to MoCSSy students, providing opportunities for collaboration and knowledge transfer.

3.2 Increased Student Mobility

Industrial and government sectors are rapidly recognizing the value that mathematical and computational modelling has in improving system performance. However, they cannot employ individuals with no understanding of their sectors. Students with expertise in one field and a strong understanding of a second field can be expected to have a strong competitive edge over other graduates in the job market.

As part of the MoCSSy program, students are encouraged to work with industrial and government sponsors on applications of modelling complex social systems. This provides students a chance to apply their skill sets to real-world problems, and build a better

understanding of the complex nature inherent social issues. Furthermore, this assists students in the acquisition and development of valuable professional skills (such as, explaining complex modelling techniques to policy-makers without modelling expertise, writing policy recommendation reports, and conducting surveys and interviews). This will greatly increase the demand for MoCSSy graduates.

In most cases, MoCSSy related research learning can be expected to be related to, but distinct from, the student's thesis research. MoCSSy students must demonstrate that the contributions in the thesis research belongs to themselves and not other team members. It may occur that collaborations with industrial and government partners through MoCSSy participation leads to academic publications and/or be incorporated into student thesis research, and in such instances, MoCSSy members are expected to respect the confidentially requests of the partners. Please consult with the Graduate Studies Office for a sample confidentiality form.

4 CERTIFICATE REQUIREMENTS

4.1 Participation in the MoCSSy certificate

Graduate students may opt to participate in the MoCSSy certificate. All students intending to participate are strongly encouraged to discuss their intentions with their supervisory committee first. If appropriate, the supervisory committee may discuss the student's intention with the MoCSSy Managing Director and/or the MoCSSy Management Committee prior to formally communicating to the MoCSSy Program their intention to participate.

4.2 Home Department Definition and Responsibilities

The department, school, or faculty to which a student is originally admitted shall be referred to as the student's *home department*. The student's home department is responsible for providing standard student administrative support (photocopying, computer access, graduate secretary access, etc...).

4.3 Tuitions and Student Fees

There are no additional fees for students in the MoCSSy program. Tuition is based on the student's home department.

4.4 Certificate Program Requirements

Students must satisfy all graduate requirements of their home department's graduate studies program.

The MoCSSy certificate requires that students take fifteen (15) credit hours (5 courses) of applicable MoCSSy courses (see Appendix 1). Of these, at least twelve of the credit hours (4 courses) must be graduate level courses.

A maximum of 9 credit hours (3 courses) may be from the students home department (consult with the MoCSSy program director regarding prior course credit eligibility).

For students in the Faculty of Applied Sciences or the Faculty of Science a minimum of six (6) credit hours must be taken in courses offered in departments outside of these Faculties. Course taken in order to meet the requirements of earlier degrees may not count towards these credit hours.

In addition, students are expected to participate in the MoCSSy graduate seminar series and workshops for at least one semester of each year they are in the program. Typically this would mean M.Sc. students participate at least twice, and Ph.D. students participate at least four times, however some flexibility will be provided to students joining the program near graduation.

4.4.1 Current MoCSSy students

Several M.Sc. students and Ph.D. students are currently active in the MoCSSy program (see Appendix 2), flexibility will be provided to these students regarding MoCSSy Certificate Program Requirements in order that they may graduate in a timely fashion.

4.5 MoCSSy Graduate Seminar Series and Workshops

The MoCSSy graduate seminar series and workshops are a collection of training events covering a variety of topics on Modelling of Complex Social Systems. The seminar series is organized by a MoCSSy Graduate Student and provides a chance for MoCSSy Graduate students to share their research. MoCSSy workshops are organized by the MoCSSy program director, and precise focus varies each semester. MoCSSy students are expected to participate in these MoCSSy events as their timetable permits.

5 PROCESS AND TIME LINES

Assuming approval every step of the way, the next steps in the process will be as follows:

- Discussions with potential host departments, *fall 2008*
- Review and approval by host Faculty Deans, *fall 2008 / spring 2009*
- Review and approval by Senate Graduate Studies Committee SGSC, *spring 2009*
- Review and Approval by Senate, *spring 2009*
- First MoCSSy certificate granted, *summer 2009*

APPENDIX 1: COURSES

Computing Science (students majoring in computing science are required to take 700/800 level courses)

CMPT 305 Computer simulation and modelling
CMPT 310 Artificial intelligence survey
CMPT 454 Database Systems II
CMPT 456 Information retrieval and Web search
CMPT 467 Visualization
CMPT 471 Networking II

CMPT 705 Design and Analysis of Algorithms
CMPT 721 Knowledge Representation and Reasoning
CMPT 740 Database Systems
CMPT 741 Data Mining
CMPT 745 Software Engineering
CMPT 764 Geometric Modeling in Computer Graphics
CMPT 765 Computer Communication Networks
CMPT 767 Visualization
CMPT 771 Internet Architecture and Protocols
CMPT 813 Computational Geometry
CMPT 814 Algorithmic Graph Theory
CMPT 815 Algorithms of Optimization
CMPT 816 Theory of Communication Networks

Criminology (students majoring in criminology are required to take 800 level courses)

CRIM 410 Decision-Making in Criminal Justice
CRIM 413 Terrorism
CRIM 454 Criminal Profiling (Surrey Campus)
CRIM 457 Crime and Criminal Intelligence Analysis

CRIM 800 Theories of Crime
CRIM 810 The Phenomena of Crime I
CRIM 811 The Phenomena of Crime II
CRIM 820 Criminal Justice Policy Analysis I
CRIM 821 Criminal Justice Policy Analysis II
CRIM 862 Research Methods III (Qualitative Analysis)

Geography (students majoring in geography are required to take 600 level courses)

GEOG 352: Spatial Analysis
GEOG 451: Spatial Modeling
GEOG 453W: Remote Sensing of Environment
GEOG 455: Theoretical and Applied GIS
GEOG 457: Geovisualization Interfaces

GEOG 604: Research Design and Analytical Techniques in Human Geography
GEOG 606: Research Design and Analytical Techniques in Physical Geography
GEOG 651: Advanced Spatial Analysis and Modeling
GEOG 653: Theoretical and Applied Remote Sensing

GEOG 655: Advanced Principles of Geographic Information Science

Health Sciences

HSCI 802 Principles of Epidemiology for Public Health
HSCI 805 Intermediate Epidemiologic Methods
HSCI 803 Qualitative and Survey Research Methods
HSCI 815 Concepts of Population and Public Health Practice
HSCI 824 Global Health Systems
HSCI 826 Program Planning and Evaluation
HSCI 827 Analysis of the Canadian Health Care Delivery System
HSCI 835 Social Behavioural Contexts of Health and Disease
HSCI 845 Environmental and Occupational Health
HSCI 861 Principles of Demographic Analysis for Health researchers

Mathematics (students majoring in mathematics are required to take 700 level courses)

MACM 316 Numerical Analysis I
MATH 308 Linear Optimization
MATH 309 Continuous Optimization
MATH 348 Probabilistic Models in Operations Research
MACM 409 Numerical Linear Algebra and Optimization
MATH 408 Discrete Optimization
MACM 416 Numerical Analysis II
MATH 445 Graph Theory
MATH 448 Network Flows

MATH 709 Numerical Linear Algebra and Optimization
MATH 708 Discrete Optimization
MATH 716 Numerical Analysis II
MATH 745 Graph Theory
MATH 748 Network Flows

Statistics (students majoring in statistics are required to take 800 level courses)

STAT 302 Analysis of Experimental and Observational Data
STAT 350 Linear Models in Applied Statistics
STAT 403 Intermediate Sampling and Experimental Design
STAT 410 Statistical Analysis of Sample Surveys
STAT 430 Statistical Design and Analysis of Experiments
STAT 602 Generalized Linear and Nonlinear Modelling
STAT 650 Quantitative Analysis in Resource Management and Field Biology

STAT 802 Multivariate Analysis
STAT 804 Time Series Analysis
STAT 805 Non-Parametric Statistics and Discrete Data Analysis
STAT 806 Lifetime Data Analysis
STAT 870 Applied Probability Models

APPENDIX 2: SUPPORT

Principal MoCSSy Faculty

- Dr. Peter Borwein (Mathematics)
- Dr. Patricia Brantingham (Criminology)
- Dr. Uwe Glaesser (Computing Science)
- Dr. Michael Hayes (Health Sciences)
- Dr. Robert Hogg (Health Sciences)
- Dr. Nadine Schuurman (Geography)
- Dr. Steve Thompson (Statistics)

MoCSSy SFU Supporting Faculty

- Dr. Martin Andresen (Criminology)
- Dr. Binay Bhattacharya (Computing Science)
- Dr. Eric Beauregard (Criminology)
- Dr. Paul Brantingham (Criminology)
- Dr. Suzana Dragicevic (Geography)
- Dr. Diane Finegood (Kinesiology)
- Dr. Robert Hogg (Health Sciences)
- Dr. Michel Joffres (Health Sciences)
- Dr. Bryan Kinney (Criminology)
- Dr. Greg Mori (Computing Science)
- Dr. Oliver Schulte (Computing Science)
- Dr. Andrew Sixsmith (Gerontology)
- Dr. Richard Vaughan (Computing Science)
- Dr. Gary Wang (Mechatronics)
- Dr. Ke Wang (Computing Science)

MoCSSy Program's Current Graduate Students

- Azadeh Alimadad (Ph.D. candidate, Health Sciences)
- Afsaneh Bakhtiari (M.Sc. candidate, Mathematics)
- Laurens Bakker (M.Sc. candidate, Computing Science)
- Chris Bone (Ph.D. candidate, Geography)
- Jiyi Chen (M.Sc. candidate, Computing Science)
- Niki Huitson (Ph.D. Candidate, Criminology)
- Piper Jackson (Ph.D. candidate, Computing Science)
- Ozge Karinfil (Ph.D. candidate, Kinesiology)
- Hassan Khosravi (Ph.D. candidate, Computing Science)
- Mani Ranjbar (Ph.D. candidate, Computing Science)
- Alireza Saremi (Ph.D. candidate, Engineering)
- Valerie Spicer (Ph.D. candidate, Criminology)
- Mona Vajihollahi (Ph.D. candidate, Computing Science)
- Kyle Vincent (Ph.D. candidate, Statistics)
- Katie Wunschke (Ph.D. candidate, Criminology)

MoCSSy External Supporters

- Dr. John Blake (Industrial Engineering, Dalhousie)
- Dr. Sally Brailsford (Management Science, U. South Hampton)
- Ms. Martha Burd (Director, Health Economics and Analysis, BC Ministry of Health)
- Sgt. Tim Chad (NCO, RCMP)
- Dr. Roberto Cominetti (Ingenieria Matematico, Universidad de Chile)
- Dr. Vahid Dabbaghian (CSMG, adjunct Mathematics SFU)
- Dr. Nicolas Figueroa (Facultad de Ciencias Fisicas y Matematicas, Universidad de Chile)
- Mr. Eduardo Garza (Manager, Operations Research, Fraser Health)
- Mr. Jason Goto (President, AnalysisWorks)
- Dr. Shane Henderson (Operations Research, Cornell)
- Mr. Steven Kabanuk (Director, Surgical Projects, Fraser Health)
- Mr. Peter Lepine (Superintendent, Coquitlam, RCMP)
- Dr. Aili Malm (Criminal Justice, California State U., Long Beach)
- Dr. Raúl Manásevich (Ingenieria Matematico, Universidad de Chile)
- Dr. Carrie Matteson (PDF Kinesiology, SFU)
- Ms. Sue Melnychuk (Director, Mental Health and Addictions, Fraser Health)
- Dr. Bojan Ramadanovic (CSMG)
- Dr. Alexander Rutherford (CSMG, adjunct Mathematics SFU)
- Ms. Nancy South (Director, Monitoring and Reporting, Ministry of Health)
- Dr. Les Vertesi, M.D. (E.R. Physician, Royal Columbian Hospital)
- Dr. Jeff Walker (Criminal Justice, U. Arkansas, Little Rock)
- Dr. Yanchao Wang (CSMG)
- Ms. Angela Wolff (Director, Clinical Education, Fraser Health)

APPENDIX 3: Management for Program Changes and Funding

Management Committee and Structure

The management committee consists of the

- MoCSSy Principal Investigators (at least 4, each from a different MoCSSy discipline),
- MoCSSy Program Director, and
- MoCSSy Managing Director.

The current *MoCSSy Principal Investigators* are

- Peter Borwein (Mathematics)
- Patricia Brantingham (Criminology)
- Uwe Glasser (Computing Science)
- Michael Hayes (Health Sciences)

These are the initial principal investigators on the SFU supported CTEF grant that helps support the MoCSSy program. The MoCSSy Principal Investigators are responsible for providing overall leadership and decision support for the MoCSSy program. This includes developing overall research directions for the program, liaising with University Deans and VPs to help promote the MoCSSy program at SFU, and selecting and hiring the Program Director and Managing Director for the MoCSSy program.

The current *MoCSSy Program Director* is Vahid Dabbaghian. The MoCSSy Program Director works closely with the MoCSSy Managing Director to ensure the day-to-day running of the MoCSSy program. This includes organizing MoCSSy symposiums, seeking new MoCSSy graduate students, providing a first filter on funding of graduate students, maintaining a high level understanding of all MoCSSy sub-projects. The MoCSSy Program Director is viewed as a short-term position; a Program Director is instated for a maximum period of 3 years.

The current *MoCSSy Managing Director* is Pam Borghardt (IRMACS, SFU). The MoCSSy Managing Director works closely with with MoCSSy Program Director to ensure the day-to-day running of the MoCSSy program. This includes personnel contracts and grant management for all MoCSSy funded researchers, and financial management support for new funding to the MoCSSy program. The MoCSSy Managing Director is viewed as a long-term position.

Program Changes

Once established, it may become necessary or desirable to change the requirements for a student to receive a special graduate certificate in MoCSSy.

- Changes in course lists for each department must be approved by the MoCSSy Management Committee, the Graduate Chair of the effected department, and the Chair of the effected department.
- Changes in requirements regarding the MoCSSy Graduate seminar series must be approved by the MoCSSy Management Committee.

- Bringing new departments into the MoCSSy Graduate Certificate program must be approved by the Management Committee, the Graduate Chair of the effected department, the Chair of the effected department, the appropriate Dean, and the SGSC.

Funding

Currently the MoCSSy program has access to CTEF funding, some of which is being used to support MoCSSy Graduate Student Members and MoCSSy Research Associates. The MoCSSy program management committee decides allocation of these funds.

In order for a student to be eligible for MoCSSy funds, the management committee must agree that

1. the student has shown appropriate interest in the MoCSSy program (for example by actively participating in the MoCSSy Graduate Seminar Series that semester).
2. the student's research fits within the MoCSSy program goals,
3. the student is of high academic standing.

Currently, MoCSSy graduate student scholarships are valued at \$8,000 for one semester. This value will be adjusted as inflation and funding dictates.

It should be noted that a student may graduate with a special certificate in MoCSSy without ever receiving MoCSSy funding.