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CRSNG Investir dans les gens, la découverte et l'innovation

FORM 101
Application for a Grant
PART I

System-ID (for NSERC use only)	Date
90296734	2007/03/05

Family name of applicant	Given name	Initial(s) of all given names	Personal identification no. (PIN)
Salahub	Dennis	D.R.	10174

Institution that will administer the grant	Language of application	Time (in hours per month) to be devoted to the proposed research / activity
Calgary	[X] English [ ] French	

Type of grant applied for	For Strategic Projects, indicate the Target Area and the Research Topic; for Strategic Networks indicate the Target Area.
Industrial Research Chair - IRC	

Title of proposal
NSERC/iCORE/Smart Technologies Industrial Research Chair in Interactive Technologies

Provide a maximum of 10 key words that describe this proposal. Use commas to separate them.
Interactive Technologies, Human Computer Interaction, Information Visualization, Digital walls and tables, Computer Supported Cooperative Work, Ubiquitous Computing, Tangible Computing

Research subject code(s)		Area of application code(s)	
Primary	Secondary	Primary	Secondary
2705	2710	802	800

CERTIFICATION/REQUIREMENTS

If this proposal involves any of the following, check the box(es) and submit the protocol to the university or college's certification committee.

Research involving : Humans [X] Human pluripotent stem cells [ ] Animals [ ] Biohazards [ ]

Does any phase of the research described in this proposal a) take place outside an office or laboratory, or b) involve an undertaking as described in Part 1 of Appendix B?

[X] NO [ ] If YES to either question a) or b) – Appendices A and B must be completed

TOTAL AMOUNT REQUESTED FROM NSERC

Year 1	Year 2	Year 3	Year 4	Year 5
100,000	100,000	100,000	100,000	100,000

SIGNATURES (Refer to instructions "What do signatures mean?")

It is agreed that the general conditions governing grants as outlined in the NSERC *Program Guide for Professors* apply to any grant made pursuant to this application and are hereby accepted by the applicant and the applicant's employing institution.

Applicant

Applicant's department, institution, tel. and fax nos., and e-mail
Office of the President
Calgary
Tel.: (403) 220-7833
FAX: (403) 289-6800
dennis.salahub@ucalgary.ca

Head of department

Dean of faculty

President of institution
(or representative)

The information collected on this form and appendices will be stored in the Personal Information Bank for the appropriate program.

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Personal identification no. (PIN)	Family name of applicant
10174	Salahub

CHAIR CANDIDATES/CHAIRHOLDERS

I have read the statement "What do signatures on the application mean?" in the accompanying instructions and agree to it.

Name	Research/ activity time (hours/month)	Type of Chair	Signature
Saul Greenberg	80	Senior	
Sheelagh Carpendale	80	Associate	

SUPPORTING ORGANIZATIONS (if organization different from page 1)

It is agreed that the general conditions governing grants as outlined in the NSERC *Program Guide for Professors,* as well as the statements "What do signatures on the application mean?" and "Summary of proposal for public release" in the accompanying instructions, apply to any grant made pursuant to this application and are hereby accepted by the organization.

Family name and given name of signing officer, title of position, and name of organization	Signature
Morrison, Gerald External Research Manager Smart Technologies, Inc. Lynn Sutherland Vice President Programs iCORE (Alberta)	

Use additional page(s) if necessary.

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Personal identification no. (PIN)	Family name of applicant
10174	Salahub

CHAIR CANDIDATES/CHAIRHOLDERS

I have read the statement "What do signatures on the application mean?" in the accompanying instructions and agree to it.

Name	Research/ activity time (hours/month)	Type of Chair	Signature
Saul Greenberg	80	Senior	
Sheelagh Carpendale	80	Associate	

SUPPORTING ORGANIZATIONS (if organization different from page 1)

It is agreed that the general conditions governing grants as outlined in the NSERC *Program Guide for Professors,* as well as the statements "What do signatures on the application mean?" and "Summary of proposal for public release" in the accompanying instructions, apply to any grant made pursuant to this application and are hereby accepted by the organization.

Family name and given name of signing officer, title of position, and name of organization	Signature
Morrison, Gerald External Research Manager Smart Technologies, Inc. Lynn Sutherland Vice President Programs iCORE (Alberta)	

Use additional page(s) if necessary.

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FORM 183A

Information Required from Organizations Participating in Research Partnerships Programs

Read the instructions before completing the Form.

GENERAL INFORMATION ON THE ORGANIZATION

Name of organization	Name and title of contact person at the organization
iCORE	Lynn Sutherland Vice President, Programs
Mailing address	**Mailing address for the contact person (only if different)**
3608 33 Street NW Calgary, Alberta T2L 2A6	
Telephone number 403 210 5335 / **Facsimile number** 403 210 5337	**Telephone number** / **Facsimile number**
E-mail address sutherland@icore.ca	**E-mail address**

Is your organization: ☐ Private sector? ☒ Government owned? ☐ Government agency/department?

Industry/Products and Services Code:

Is your organization: ☐ Profit-motivated? ☒ Not-for-profit?

Web site: www.icore.ca

Canadian ownership (in percentage) (If Applicable): 100 %

Date of incorporation in Canada (If Applicable): sept 23/99

Total number of employees in Canada: 6

Types of products sold and/or services offered: Fund ICT Research in Alberta

Total annual sales for previous year (If Applicable):

Net profit (loss) for previous year (If Applicable):

Is your organization: ☐ a parent company? ☐ a subsidiary of? (specify)

RESEARCH AND DEVELOPMENT ACTIVITIES

Does your organization have an R&D department? Yes ☐ No ☒

If not, does it undertake R&D within the organization's premises? Yes ☐ No ☒

Number of R&D staff in Canada
Scientists and technicians:

R&D staff with a PhD:

Annual R&D expenditures (previous/ current / next year): $12M / $12M / $13M

APPLICANT INFORMATION

Family name	Given names	Initial(s) of all given names
SALAHUB	DENNIS	D.

Title of proposal: NSERC/iCORE/SMART Technologies Chairs in Interactive Technologies

Personal identification no. (PIN): 10174

Appl ID (for NSERC use only):

ORGANIZATION'S CONTRIBUTIONS

Contributions to the direct costs of research	Year 1	Year 2	Year 3	Year 4	Year 5
a) Cash contribution	100,000	100,000	100,000	100,000	100,000
b) In-kind contribution					

Has your organization received publicly-funded support for R&D directly related to the proposed project? Yes ☒ No ☐

Are the applicant and co-applicant(s) at arm's length from your organization? Yes ☒ No ☐

Name, title and telephone number of authorized representative of the organization: Lynn Sutherland, Vice President, iCORE 403-210-5335

Signature:

Date: Feb 23/07

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FORM 183A

Information Required from Organizations Participating in Research Partnerships Programs

Read the instructions before completing the Form.

GENERAL INFORMATION ON THE ORGANIZATION

Name of organization	Name and title of contact person at the organization
SMART Technologies Inc.	Gerald GDM Morrison, External Research Manager
Mailing address	**Mailing address for the contact person (only if different)**
1207 11th AVE SW SUITE 300 CALGARY, AB CANADA T3C 0M5	
Telephone number / **Facsimile number**	**Telephone number** / **Facsimile number**
403 451 2035	1 (403) 451-2035
E-mail address	**E-mail address**
	GeraldM@smarttech.com

Is your organization
[X] Private sector? [ ] Government owned? [ ] Government agency/department?

Industry/Products and Services Code: 2901 5700

Is your organization [X] Profit-motivated? [ ] Not-for-profit?

Web site: WWW.SMARTTECH.COM

Canadian ownership (in percentage) (If Applicable)	Date of incorporation in Canada (If Applicable)	Total number of employees in Canada
73 %	/	900

Types of products sold and/or services offered
Interactive Touch Displays, Software

Total annual sales for previous year (If Applicable)

Net profit (loss) for previous year (If Applicable)

Is your organization [X] a parent company? [ ] a subsidiary of? (specify)

RESEARCH AND DEVELOPMENT ACTIVITIES

Does your organization have an R&D department? Yes [X] No [ ]

If not, does it undertake R&D within the organization's premises? Yes [ ] No [ ]

Number of R&D staff in Canada
Scientists and technicians:

R&D staff with a PhD:

Annual R&D expenditures (previous/ current / next year)
/ /

APPLICANT INFORMATION

Family name	Given names	Initial(s) of all given names
SALAHUB	DENNIS	D

Title of proposal
NSERC/iCORE/Smart Technologies Chairs in Interactive Technologies

Personal identification no. (PIN): 10174

Appl ID (for NSERC use only)

ORGANIZATION'S CONTRIBUTIONS

Contributions to the direct costs of research	Year 1	Year 2	Year 3	Year 4	Year 5
a) Cash contribution	100,000	100000	100,000	100000	100,000
b) In-kind contribution	25,000	25,000	25,000	25,000	25,000

Has your organization received publicly-funded support for R&D directly related to the proposed project? Yes [ ] No [X]

Are the applicant and co-applicant(s) at arm's length from your organization? Yes [X] No [ ]

Name, title and telephone number of authorized representative of the organization	Signature	Date
Dennis Salahub 1 (403) 220-7833 GERALD MORRISON 403 451 2035		28FEB07

Personal identification no. (PIN)	Family name of applicant
10174	Salahub

SUMMARY OF PROPOSAL FOR PUBLIC RELEASE (Use plain language.)

This plain language summary will be available to the public if your proposal is funded. Although it is not mandatory, you may choose to include your business telephone number and/or your e-mail address to facilitate contact with the public and the media about your research.

Business telephone no. (optional): 001 (403) 220-6087 / 6005

E-mail address (optional): saul.greenberg@ucalgary.ca or sheelagh@cpsc.ucalgary.ca

Modern society demands that people manage, communicate and interact with digital information and digital devices at an ever-increasing pace. The problem is not with the information itself, but rather with its sheer volume and the unwieldy ways now provided to present, exchange, view and interact with it. Consequently, the overall objective of the Chair is to: design, develop and evaluate interactive technologies so that they support the everyday-world practices of how people view, represent, manage, and interact with information and how they collaborate with it. The Chair will realize this objective through two inter-related research themes. First, interactive visualization investigates the possibilities the digital world affords for peoples' exploration of dense and complex information spaces. The overall goal is to promote comprehension by providing people with appropriate interactive technologies and digital displays that help them transform information into knowledge. Second, embodied interaction considers how the technology that displays this information can be designed as a truly integral part of the real world environment. The overall goal is to create new displays and devices that fit, support and participate in - rather than ignore - the everyday-world social practices of people and their surrounding environment. Both themes are tightly intertwined: Interactive visualization considers the fundamental nature of information and how people can effectively interact with it through technology, while embodied interaction considers how these technologies manifest themselves in ways that exploit the everyday practices and routines of people.

As Chair partners, Carpendale and Greenberg's combined expertise leverage one another's abilities to reconsider novel designs of interactive technologies. Both have a strong history of collaboration with their industrial sponsor, Smart Technologies, Inc., a sponsorship that includes an Industrial Chair co-funded by Smart Technologies, Inc. and Alberta's iCORE agency.

Second Language Version of Summary (optional).

Personal identification no. (PIN)	Family name of applicant
10174	Salahub

ACTIVITY SCHEDULE
(Refer to instructions to see if this section applies to your application. Use additional page(s) if necessary.)

Milestone	Description of activities	Anticipated starting date	Anticipated completion date
Foundations: Visualizing Uncertainty	Determine how techniques established in information visualization and human computer interaction can be applied to improve uncertainty visualizations and how people can understand and manage uncertainty effectively.	2007-01-01	2009-12-31
Applications: Visualizing Uncertainty	Create, refine and study uncertainty visualizations in particular domains, e.g., natural language machine translations and diagnostic data.	2009-01-01	2011-12-31
Foundations: Visual Decision Support	Develop an increased understanding of how people reason, manage information and reach decisions, and from this develop interactive visualization that addresses uncertainty in reasoning.	2007-01-01	2009-12-31
Applications: Visual Decision Support	Develop and study visual decision support (and generalized infrastructures) for particular application domains, e.g., mountain pine beetle management, command and control situations, diagnostic decision processes.	2009-01-01	2011-12-31
Foundations: Accessing Information Details	Apply previously developed detail-in-context techniques to develop direct touch widgets for information access and organization, and to address resolution differences in touch input and display output.	2007-01-01	2009-12-31
Application: Accessing Information Details	Apply developed detail-in-context techniques to create local magnification and information drill-down techniques, and to support visual comparisions.	2009-01-01	2011-12-31
Foundations: Social Visualization	Develop interactive visualizations of social phenomena, e.g., typing characteristics, very large relational lexical databases, and document content.	2007-01-01	2009-12-31
Continuation: Social Visualization	Develop visualization techniques that visually link visualizations of different uses of the same data, and that helps compare one use of a data set to another.	2009-01-01	2011-12-31

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ACTIVITY SCHEDULE
(Refer to instructions to see if this section applies to your application. Use additional page(s) if necessary.)

Milestone	Description of activities	Anticipated starting date	Anticipated completion date
Foundations: Collaborative Visualization	Develop (through observations) an increased understanding of how people, singly or in groups use visualizations, and apply this understanding to the design of collaborative visualizations.	2007-01-01	2009-12-31
Application: Collaborative Visualization	Develop re-purposable interface components for collaborative visualizations (including visual compare and contrast techniques), and integrate these into a collaborative visualization environment.	2009-01-01	2011-12-31
Foundations: Understanding Social Practices	Develop an increased understanding of how small groups of people casually interact, and how they work with information within domestic environments, on tabletops, on wall displays, and combinations of these	2007-01-01	2009-12-31
Application: Understanding Social Practices	Develop an increased understanding of social practices in particular domains, e.g., household members in domestic environments, teams collaborate during shift change, and how people explain and making use of visual information.	2009-01-01	2011-12-31
Application: Collocated and distributed groupware interactio	Using the knowledge gained in other milestones, create interaction techniques to support casual interaction for telecommuters, for letting co-located people monitor information on large displays, and for constructing domestic information appliances.	2007-01-01	2011-12-31
Direct touch interactive large display technologies	Create, study and refine techniques for direct touch interactive large display, including shallow depth 3D interactions, data entry on large direct-touch displays, for spatially explicit interactions, and for multimodal interaction.	2007-01-01	2011-12-31
Infrastructure for embodied interaction.	Creeate infrastructures and tools so that the entire research team can efficiently prototype and interate over novel interaction techniques, e.g., shared data toolkit, shared physical user interface toolkit, and a large display architecture	2008-01-01	2011-12-31

Personal identification no. (PIN)	Family name of applicant
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Calculate the sum total expenditures and contributions from individual budget pages 5 and 6 transfer the amounts to this Consolidated Budget page. When using the On-line System to complete the form, this Consolidated Budget page will be automatically generated with the information you have already entered.

CONSOLIDATED BUDGET (Proposed Expenditure and Contributions from Supporting Organizations)

	Year 1	Year 2	Year 3	Year 4	Year 5
Cash expenses					
Senior/Executive Chair Salary Costs	176,674	176,674	176,674	176,674	176,674
Associate Chair Salary Costs	148,949	148,949	148,949	148,949	148,949
Senior/Associate Chair Research Program Costs	310,000	310,000	310,000	310,000	310,000
xxx Intentionally left blank xxx	0	0	0	0	0
Total cash expenses	**635,623**	**635,623**	**635,623**	**635,623**	**635,623**
Cash contributions to Chair program (not including overhead)					
Industry	100,000	100,000	100,000	100,000	100,000
University	235,623	235,623	235,623	235,623	235,623
Other	200,000	200,000	200,000	200,000	200,000
Total amount requested from NSERC	100,000	100,000	100,000	100,000	100,000
Total cash contributions	**635,623**	**635,623**	**635,623**	**635,623**	**635,623**
"Cash equivalent" in-kind contributions to direct costs of research					
Industry	0	0	0	0	0
University	0	0	0	0	0
Other	0	0	0	0	0
Total "cash equivalent" in-kind contributions	**0**	**0**	**0**	**0**	**0**
Other in-kind contributions to direct costs of research					
Industry	25,000	25,000	25,000	25,000	25,000
University	0	0	0	0	0
Other	0	0	0	0	0
Total other in-kind contributions	**25,000**	**25,000**	**25,000**	**25,000**	**25,000**

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Before completing this section, **read the instructions** and consult the *Use of Grant Funds* section in the NSERC Program Guide for Professors concerning the eligibility of expenditures for the direct costs of research and the regulations governing the use of grant funds. Calculate the sum total expenditures for each category from individual Chair budget pages 5-1 to 5-# and transfer the totals to this page. Calculate the sum total cash contributions from industry, university and other sources (individual budget pages 6-1 to 6-#) and transfer the totals to this page. Calculate the amount requested from NSERC.
When using the On-line System to complete the form, this SUM TOTAL page will be automatically generated with the information you have already entered.

PROPOSED EXPENDITURES FOR DIRECT COSTS OF RESEARCH (include cash expenditures only)

SUM TOTAL (for all Chair candidates/Chairholders)

	Year 1	Year 2	Year 3	Year 4	Year 5
Chair Salary Costs					
Salary and benefits	325,623	325,623	325,623	325,623	325,623
Research Program Costs					
1) Salaries and benefits					
a) PhD students	38,000	38,000	38,000	38,000	38,000
b) Master's students	49,500	49,500	49,500	49,500	49,500
c) Undergraduate students	0	0	0	0	0
d) Postdoctoral fellows	120,000	120,000	120,000	120,000	120,000
e) Technical/professional assistants	35,000	35,000	35,000	35,000	35,000
f)	0	0	0	0	0
2) Equipment or facility					
a) Purchase or rental	32,500	32,500	32,500	32,500	32,500
b) Operation and maintenance costs	0	0	0	0	0
c) User fees	0	0	0	0	0
3) Materials and supplies	0	0	0	0	0
4) Travel					
a) Conferences	35,000	35,000	35,000	35,000	35,000
b) Field work	0	0	0	0	0
c) Project-related	0	0	0	0	0
5) Dissemination costs					
a) Publication costs	0	0	0	0	0
b)	0	0	0	0	0
6) Other (specify)					
a)	0	0	0	0	0
b)	0	0	0	0	0
Total Research Program Costs	**310,000**	**310,000**	**310,000**	**310,000**	**310,000**
TOTAL CASH EXPENSES (Chair Salary Costs + Total Research Program Costs)	**635,623**	**635,623**	**635,623**	**635,623**	**635,623**
Total cash contributions to Chair program (not including overhead) from industry, if applicable.	100,000	100,000	100,000	100,000	100,000
Total cash contributions to Chair program (not including overhead) from university, if applicable.	235,623	235,623	235,623	235,623	235,623
Total cash contributions to Chair program (not including overhead) from other sources, if applicable.	200,000	200,000	200,000	200,000	200,000
TOTAL AMOUNT REQUESTED FROM NSERC (transfer to page 1)	100,000	100,000	100,000	100,000	100,000

Personal identification no. (PIN)	Family name of applicant
10174	Salahub

Before completing this section, **read the instructions** and consult the *Use of Grant Funds section in the NSERC Program Guide for Professors* concerning the eligibility of expenditures for the direct costs of research and the regulations governing the use of grant funds.

PROPOSED EXPENDITURES FOR DIRECT COSTS OF RESEARCH (include cash expenditures only)

Name of Chair candidate/Chairholder: Greenberg/Carpendale Type of Chair: Senior/Associate (both manage the research program costs)

	Year 1	Year 2	Year 3	Year 4	Year 5
Chair Salary Costs					
Salary and benefits					
Research Program Costs					
1) Salaries and benefits					
a) PhD students	38,000	38,000	38,000	38,000	38,000
b) Master's students	49,500	49,500	49,500	49,500	49,500
c) Undergraduate students	0	0	0	0	0
d) Postdoctoral fellows	120,000	120,000	120,000	120,000	120,000
e) Technical/professional assistants	35,000	35,000	35,000	35,000	35,000
f)	0	0	0	0	0
2) Equipment or facility					
a) Purchase or rental	32,500	32,500	32,500	32,500	32,500
b) Operation and maintenance costs	0	0	0	0	0
c) User fees	0	0	0	0	0
3) Materials and supplies	0	0	0	0	0
4) Travel					
a) Conferences	35,000	35,000	35,000	35,000	35,000
b) Field work	0	0	0	0	0
c) Project-related	0	0	0	0	0
5) Dissemination costs					
a) Publication costs	0	0	0	0	0
b)	0	0	0	0	0
6) Other (specify)					
a)	0	0	0	0	0
b)	0	0	0	0	0
Total Research Program Costs	**310,000**	**310,000**	**310,000**	**310,000**	**310,000**
TOTAL CASH EXPENSES (Chair Salary Costs + Total Research Program Costs)	**310,000**	**310,000**	**310,000**	**310,000**	**310,000**
Total cash contributions to Chair program (not including overhead) from industry, if applicable.					
Total cash contributions to Chair program (not including overhead) from university, if applicable.					
Total cash contributions to Chair program (not including overhead) from other sources, if applicable.					
TOTAL AMOUNT REQUESTED FROM NSERC (transfer to page 1)					

Personal identification no. (PIN)	Family name of applicant
10174	Salahub

Before completing this section, **read the instructions** and consult the *Use of Grant Funds section in the NSERC Program Guide for Professors* concerning the eligibility of expenditures for the direct costs of research and the regulations governing the use of grant funds.

PROPOSED EXPENDITURES FOR DIRECT COSTS OF RESEARCH (include cash expenditures only)

Name of Chair candidate/Chairholder: Greenberg, Saul Type of Chair: Senior

	Year 1	Year 2	Year 3	Year 4	Year 5
Chair Salary Costs					
Salary and benefits	**176,674**	**176,674**	**176,674**	**176,674**	**176,674**
Research Program Costs					
1) Salaries and benefits					
a) PhD students	0	0	0	0	0
b) Master's students	0	0	0	0	0
c) Undergraduate students	0	0	0	0	0
d) Postdoctoral fellows	0	0	0	0	0
e) Technical/professional assistants	0	0	0	0	0
f)	0	0	0	0	0
2) Equipment or facility					
a) Purchase or rental	0	0	0	0	0
b) Operation and maintenance costs	0	0	0	0	0
c) User fees	0	0	0	0	0
3) Materials and supplies	0	0	0	0	0
4) Travel					
a) Conferences	0	0	0	0	0
b) Field work	0	0	0	0	0
c) Project-related	0	0	0	0	0
5) Dissemination costs					
a) Publication costs	0	0	0	0	0
b)	0	0	0	0	0
6) Other (specify)					
a)	0	0	0	0	0
b)	0	0	0	0	0
Total Research Program Costs	**0**	**0**	**0**	**0**	**0**
TOTAL CASH EXPENSES (Chair Salary Costs + Total Research Program Costs)	**176,674**	**176,674**	**176,674**	**176,674**	**176,674**
Total cash contributions to Chair program (not including overhead) from industry, if applicable.					
Total cash contributions to Chair program (not including overhead) from university, if applicable.					
Total cash contributions to Chair program (not including overhead) from other sources, if applicable.					
TOTAL AMOUNT REQUESTED FROM NSERC (transfer to page 1)					

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Personal identification no. (PIN)	Family name of applicant
10174	Salahub

Before completing this section, **read the instructions** and consult the *Use of Grant Funds section in the NSERC Program Guide for Professors* concerning the eligibility of expenditures for the direct costs of research and the regulations governing the use of grant funds.

PROPOSED EXPENDITURES FOR DIRECT COSTS OF RESEARCH (include cash expenditures only)

Name of Chair candidate/Chairholder: Carpendale, Sheelagh — Type of Chair: Associate

	Year 1	Year 2	Year 3	Year 4	Year 5
Chair Salary Costs					
Salary and benefits	**148,949**	**148,949**	**148,949**	**148,949**	**148,949**
Research Program Costs					
1) Salaries and benefits					
a) PhD students	0	0	0	0	0
b) Master's students	0	0	0	0	0
c) Undergraduate students	0	0	0	0	0
d) Postdoctoral fellows	0	0	0	0	0
e) Technical/professional assistants	0	0	0	0	0
f)	0	0	0	0	0
2) Equipment or facility					
a) Purchase or rental	0	0	0	0	0
b) Operation and maintenance costs	0	0	0	0	0
c) User fees	0	0	0	0	0
3) Materials and supplies	0	0	0	0	0
4) Travel					
a) Conferences	0	0	0	0	0
b) Field work	0	0	0	0	0
c) Project-related	0	0	0	0	0
5) Dissemination costs					
a) Publication costs	0	0	0	0	0
b)	0	0	0	0	0
6) Other (specify)					
a)	0	0	0	0	0
b)	0	0	0	0	0
Total Research Program Costs	**0**	**0**	**0**	**0**	**0**
TOTAL CASH EXPENSES (Chair Salary Costs + Total Research Program Costs)	**148,949**	**148,949**	**148,949**	**148,949**	**148,949**
Total cash contributions to Chair program (not including overhead) from industry, if applicable.					
Total cash contributions to Chair program (not including overhead) from university, if applicable.					
Total cash contributions to Chair program (not including overhead) from other sources, if applicable.					
TOTAL AMOUNT REQUESTED FROM NSERC (transfer to page 1)					

PROTECTED WHEN COMPLETED

Personal identification no. (PIN)	Family name of applicant
10174	Salahub

Before completing this section, read the instructions on contributions from supporting organizations and consult the *Use of Grant Funds* section in the NSERC *Program Guide for Professors* concerning the eligibility of expenditures for the direct costs of research, the regulations governing the use of grant funds, and the *Guidelines for Evaluating Cost-Sharing Ratios and In-Kind Contributions in University-Industry Collaborations* concerning the eligibility of in-kind contributions. Complete this section if you are reporting in-kind contributions for the direct costs of research. Submit a separate copy for each supporting organization.

Name of supporting organization

Smart Technologies, Inc.

CONTRIBUTIONS FROM SUPPORTING ORGANIZATIONS

	Year 1	Year 2	Year 3	Year 4	Year 5
Cash contributions to Chair program (not including overhead). Transfer amounts to page 5.	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**
"Cash equivalent" in-kind contributions to direct costs of research					
1) Donation of equipment	0	0	0	0	0
2) Donation of material	0	0	0	0	0
3) Provision of technical services	0	0	0	0	0
4)	0	0	0	0	0
Total "cash equivalent" in-kind contributions	**0**	**0**	**0**	**0**	**0**
Other in-kind contributions to direct costs of research					
1) Salaries of scientific and technical staff	25,000	25,000	25,000	25,000	25,000
2)	0	0	0	0	0
Total other in-kind contributions	**25,000**	**25,000**	**25,000**	**25,000**	**25,000**
Total in-kind contributions to direct costs of research	**25,000**	**25,000**	**25,000**	**25,000**	**25,000**
Contributions to university overhead	**0**	**0**	**0**	**0**	**0**

Personal identification no. (PIN)	Family name of applicant
10174	Salahub

Before completing this section, read the instructions on contributions from supporting organizations and consult the *Use of Grant Funds* section in the NSERC *Program Guide for Professors* concerning the eligibility of expenditures for the direct costs of research, the regulations governing the use of grant funds, and the *Guidelines for Evaluating Cost-Sharing Ratios and In-Kind Contributions in University-Industry Collaborations* concerning the eligibility of in-kind contributions. Complete this section if you are reporting in-kind contributions for the direct costs of research. Submit a separate copy for each supporting organization.

Name of supporting organization

iCORE Informatics Cirle of Research Excellence (Gov't of Alberta)

CONTRIBUTIONS FROM SUPPORTING ORGANIZATIONS

	Year 1	Year 2	Year 3	Year 4	Year 5
Cash contributions to Chair program (not including overhead). Transfer amounts to page 5.	**200,000**	**200,000**	**200,000**	**200,000**	**200,000**
"Cash equivalent" in-kind contributions to direct costs of research					
1) Donation of equipment	0	0	0	0	0
2) Donation of material	0	0	0	0	0
3) Provision of technical services	0	0	0	0	0
4)	0	0	0	0	0
Total "cash equivalent" in-kind contributions	**0**	**0**	**0**	**0**	**0**
Other in-kind contributions to direct costs of research					
1) Salaries of scientific and technical staff	0	0	0	0	0
2)	0	0	0	0	0
Total other in-kind contributions	**0**	**0**	**0**	**0**	**0**
Total in-kind contributions to direct costs of research	**0**	**0**	**0**	**0**	**0**
Contributions to university overhead	**0**	**0**	**0**	**0**	**0**

Personal identification no. (PIN)	Family name of applicant
10174	Salahub

Before completing this section, read the instructions on contributions from supporting organizations and consult the *Use of Grant Funds* section in the NSERC *Program Guide for Professors* concerning the eligibility of expenditures for the direct costs of research, the regulations governing the use of grant funds, and the *Guidelines for Evaluating Cost-Sharing Ratios and In-Kind Contributions in University-Industry Collaborations* concerning the eligibility of in-kind contributions. Complete this section if you are reporting in-kind contributions for the direct costs of research. Submit a separate copy for each supporting organization.

Name of supporting organization

Calgary

CONTRIBUTIONS FROM SUPPORTING ORGANIZATIONS

	Year 1	Year 2	Year 3	Year 4	Year 5
Cash contributions to Chair program (not including overhead). Transfer amounts to page 5.	**235,623**	**235,623**	**235,623**	**235,623**	**235,623**
"Cash equivalent" in-kind contributions to direct costs of research					
1) Donation of equipment	0	0	0	0	0
2) Donation of material	0	0	0	0	0
3) Provision of technical services	0	0	0	0	0
4)	0	0	0	0	0
Total "cash equivalent" in-kind contributions	**0**	**0**	**0**	**0**	**0**
Other in-kind contributions to direct costs of research					
1) Salaries of scientific and technical staff	0	0	0	0	0
2)	0	0	0	0	0
Total other in-kind contributions	**0**	**0**	**0**	**0**	**0**
Total in-kind contributions to direct costs of research	**0**	**0**	**0**	**0**	**0**
Contributions to university overhead	**0**	**0**	**0**	**0**	**0**

Budget Justification

***Note**: All research program costs are considered as a combined budget managed by both the Senior and Associate Chair; this is done because this is a unified research program where actual decisions affecting the research program are done by both Chair partners .*

Existing/future contributions from Supporting Organizations.
Alberta's iCORE agency awarded the applicants an industrial chair as of September 2006 for five years. The financial parameters for contributions of all organizations each year were:

Existing

- $100,000. / year was committed by Smart Technologies, Inc. to the research program.
- $100,000. / year was committed by iCORE to the research program as a match to this industrial donation.
- $ 10,000. / year would be contributed by the Department of Computer Science dedicated towards equipment funding, conditional on budget availability.

Anticipated

- $100,000. / year is requested from NSERC as a further match to the industrial donation (this NSERC IRC application).
- If successful, a further $100,000. / year would be committed by iCORE to match the NSERC IRC grant.
- As part of the NSERC IRC, the University would cover chair salaries, where any freed up monies from the NSERC contributions to these salaries would be applied to new hires that directly or indirectly support the Chair area.

To give a complete picture of the combined iCORE/NSERC IRC, the budget in this application includes the accepted budget to iCORE (i.e., 200K), the NSERC portion (i.e., 100K), the Department of Computer Science (Calgary) portion (i.e., 10K), the budget we anticipated providing to iCORE for a future match (i.e., 100K), and a University of Calgary portion that covers Chair salaries.

Chair Candidates' salary costs (325,623)**.** Salary costs are based on each candidate's current base salary plus an expected 6% increase that will accrue before the chair begins. The candidate's market supplement is then added to this base salary (as this is fixed over every year), and 20.5% overhead added (this is the standard overhead ratio determined by the University of Calgary). A CRC salary supplement of 10K to Carpendale is not included in this figure. As required by NSERC rules, expected yearly increases to salary are not reflected in these salary costs; these increases will be paid by the university outside of the Industrial Research Chair budget. The university will contribute the majority of this salary, with the remaining balance supplied by the NSERC contribution to the Chair Salary Costs (i.e., a portion of the 100,000 NSERC matching as determined by NSERC). See the paragraph below titled 'new hires relevant to the Chair' for further information on how these contributions will be used.

Research program costs. This budget is focused on extending the capabilities of the Chairs' high-end laboratory. To understand this budget, some context is needed. The Chair partners currently run a very active research laboratory, called Interactions Laboratory, within the Department of Computer Science; its space, maintenance and furnishings are provided primarily by the University. The laboratory, which comprises three large open-planned interconnected rooms, is used by three faculty members (including the Chairs) and a mix of graduate students, postdoctoral researchers, undergraduate research assistants, research interns, research employees, and research visitors. Depending on the moment, the Interactions Laboratory is populated by 20 – 30 active researchers and an administrative assistant. The laboratory is

well equipped. Each student / researcher has a cubicle with modern furniture and a high-end workstation. Specialized equipment dedicated to research projects includes a variety of standard and custom-made large vertical displays and digital tables, a Home Space, and an area for Robotics research. Ancillary rooms attached to the laboratory includes a specialized library and breakout room, an equipment storage room, three faculty offices, and three other offices used by postdoctoral researchers and visiting researchers. A seminar room, while not owned by the laboratory, is also attached to it and is commonly used for laboratory meetings.

While partial funding is in place for student support, this depends on other grants that will complete during the Chair period. The laboratory already has (or is applying for) the specialized equipment necessary for doing the research. What is lacking – and what will be filled by this budget – are the resources (salaries, travel, and some basic equipment) necessary to support the collective research activity of the laboratory (primarily Postdocs and an administrative assistant), and to cover HQP funding shortfalls (MSc/PhD students).

PhD and MSc students (38,000 PhD + 49,500 MSc / year). Other grants and scholarships are currently being used to fund the majority – but not all – of the graduate students in the Interactions Laboratory. As well, one major grant held by both Chair applicants will complete in a few years, leaving a considerable shortfall in graduate student funding. To relieve this shortfall, this budget includes funding for two PhD students and 3 MSc students for each year (budgeted amounts are based on NSERC recommendations for student supplements). Given the large number of students we train, this is a fairly modest number. The monies required for these positions will come from a combination of NSERC's grant to the Research Program Costs and from iCORE's matching grant.

Postdoctorate Fellows (120,000 / year). The budget includes line items of 60,000 per year for two Post Doctorate Fellows that will work directly with the Chair partners. Depending on the person who applies, staffing of these positions may be realized as a mix of a Postdoctoral and a Research Associate-level position. These salaries are realistic in terms of what is the minimum now required to attract and retain top Postdocs in Computer Science. These senior researchers will be responsible for long-term research projects, for integrative projects that bridge smaller project deliverables of graduate students, and for creating and maintaining research aspects of the laboratory infrastructure necessary for high quality activities of its members. If actual salaries and benefits of these researchers are below the 60,000 salaries per category, the balance will be applied to fund additional graduate students. The monies required for these positions have been accepted as part of the existing iCORE Chair budget. We are now interviewing applicants.

Technical Assistant (35,000 / year)**.** The budget includes one administrative support staff per year to assist with more routine aspects of research management, administration and out-reach for the Co-Chairs' laboratory. The monies required for this position have been accepted as part of the existing iCORE Chair budget, and a person has been hired as of Fall, 2006 (Robin Arsenault).

Travel (35,000 / year). The travel budget is used mainly to fund the Chairs, the Postdoctoral Fellows, and graduate students to attend conferences for research dissemination and to visit other laboratories as needed. Given the importance of conferences in Computer Science and that many of our graduate students present their research there, a good travel budget is critical. The monies required for these positions have been accepted as part of the existing iCORE Chair budget.

Equipment (32,500 per year). The equipment budget is used mainly for maintaining and purchasing equipment paraphernalia and software necessary for the research, and for upgrading computer workstations as needed to maintain our state-of-the-art research environment over the grant period. 22,500 of this budget has been accepted as part of the existing iCORE Chair budget, with the remaining 10,000 balance anticipated to come from a combination of NSERC's grant to the Research Program

Costs and from iCORE's matching grant. No quotations are included, as individual equipment costs are well below the $25K minimum threshold requested by NSERC. For example, we anticipate routine replacement of approximately 5 aging workstations for HQP and for our specialized equipment / year (~4500 each computer). Similarly, we expect software upgrades (~3K/year), minor equipment such as web cameras and headsets for student use (~2K/year), plus one-off demands for maintaining specialized equipment (e.g., repairs, parts replacement, cabling, mounting, container construction) (~ 5K/year).

New Hires relevant to the Chair. Not included explicitly in the budget but very relevant to it are how freed up monies will be applied towards new hires. A portion of the NSERC contribution will be applied to the Chair Salary Costs; this freed up money will be used in turn by the University to partially fund two new hires. Similarly, a portion of the iCORE matching funds will be applied directly to partially fund the two new hires. If successful, a total of $100,000 / year will be directed from NSERC (through freed-up salaries) and iCORE (through direct funding) towards these positions.

Contributions from Supporting Organizations

SMART has committed 25,000 / year for each year in in-kind contributions. The breakdown of this in-kind contribution roughly translates into two line items, where this pattern of contribution reflects our past experiences with SMART, our conversations with SMART leading up to this application, and their direct acknowledgement of this expectation in their IRC support letter.

- ***Salary in-kind.*** SMART salary will be the primary use of the in-kind contribution. Staff from SMART will devote their time to work directly with the chairs. This will certainly occur as part of the regular exchanges between the co-Chair applicants and the SMART Research Manager, Gerald Morrison. From our prior experiences, it will also occur as part of the regular exchanges with other researchers and developers who have a mutual interest in particular projects. We also anticipate that some projects will involve SMART Staff working directly with the co-Chairs, e.g., as happened in the past in the design of a horizontal digital table.
- ***Equipment in-kind.*** Smart Technologies, Inc. have been very generous with equipment in the past. When specialized equipment is needed, they often make it available either as a direct donation or at significantly reduced prices. As well, they have developed – at their cost – specialized equipment solely for our use. We anticipate this generous behaviour will continue during the chair period as opportunities arise.

Relationship to Other Research Support

Grants directly related to this NSERC IRC application. This NSERC IRC application directly complements the recently awarded ***iCORE Industrial Chair***. Consequently, the iCORE/Smart Technologies Chair budget is directly factored into this budget as a combined budget, where it includes monies already awarded as well as anticipated matching monies if this grant is successful (see budget justification). The original budget supplied to iCORE also anticipated this complementary relationship; the two together are crucial for realizing the Chair vision. As described in the original iCORE budget, if this NSERC IRC application is not successful, then we will have to release one or both Postdoc positions budgeted as part of the iCORE chair, where that funding would be reapplied towards graduate student support.

Grants held/applied for by the proposed chairholders. Both Carpendale and Greenberg have several other grants that support their research activities. However, these other grants do not suffice to fully fund all the research possible, and thus certain sub-projects can either not be started, or they cannot be pursued to the depth they deserve, or they cannot be pursued beyond the tenure of an individual graduate student. Thus the Chair would directly complement these other grants, where it will fund senior researchers, research support, and equipment so that all projects will get the attention they deserve. Through salary costs and freed up monies, it will also provide for two new hires. Each major grant and its relationship to the current grant are described below.

- Carpendale and Greenberg are both members of the ***NSERC Research Networks Grant*** (Nectar), which predominantly funds most – but not all – the Co-Chair's graduate students within the laboratory. In combination with other grants, this is why the Co-Chair budget has only a modest request for graduate students in spite of the number of students they take on. This grant ends in two years.
- Greenberg and Carpendale's ***NSERC Discovery Grants*** provide only enough funding to cover basic operational needs. We anticipate that these grants will be renewed at levels similar to exiting levels, and this is factored into our budget request.
- It should be noted that Carpendale and Greenberg currently manage to run a research lab beyond the means of the above three grants because they both have been successful in attracting top calibre graduate students, many of whom (currently 70%) have their own full scholarships.
- Carpendale holds a ***Canada Research Chair*** in Information Visualization that provides some teaching relief and a modest research stipend that is used to support graduate students and research assistants.
- Greenberg has been awarded a ***University Professorship*** and has been nominated for a Killam Research Fellowship. Both grants provide some teaching / service relief time and modest funding during the IRC period, and will thus allow Greenberg to focus on the proposed research.
- Carpendale has a ***New Opportunities CFI*** grant that provided the means of obtaining many of the large displays currently in the laboratory. She also has a CFI grant in conjunction with her CRC Chair. This second CFI grant is in the process of being finalized and has enabled the creation of the new and improved high resolution digital table (in collaboration with Smart Technologies, Inc). Greenberg has recently received an ***NSERC Research Tools and Instruments (Equipment)*** grant. Both awards have supplied the base equipment necessary for the proposed IRC. Greenberg and Carpendale have also applied for a new NSERC Research Tools and Instruments (Equipment) grant, which if awarded will allow for advanced research explorations related to this application.

Personal identification no. (PIN)	Family name of applicant
10174	Salahub

Before completing this section, read the instructions for the Letters of Reference. Indicate below the name (mandatory), organization and country (optional) of each of the three persons who will be providing letters of reference for each Chair candidate.

LETTERS OF REFERENCE

Name of Chair candidate	References	Reference Name / Organization / Country
Saul Greenberg	1	Bill Buxton / Microsoft Research / UNITED STATES
	2	Tom Rodden / University of Nottingham / UNITED KINGDOM
	3	Ron Baecker / University of Toronto / CANADA
Sheelagh Carpendale	1	Carl Gutwin / University of Saskatchewan / CANADA
	2	Thomas Strothotte / Universität Rostock / GERMANY
	3	Brian Wyvill / University of Victoria / CANADA
	1	
	2	
	3	
	1	
	2	
	3	
	1	
	2	
	3	
	1	
	2	
	3	

Canada

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Personal identification no. (PIN)	Family name of applicant
10174	Salahub

INTELLECTUAL PROPERTY

Complete this section if you need to discuss the plans for protecting and disposing of intellectual property arising from the grant. Do not exceed one page.

The university and Smart Technologies are negotiating an IP agreement as part of the iCORE Industrial Chair awarded to Carpendale and Greenberg. As this NSERC IRC application leverages the iCORE Chair, the wording of the IP agreement is phrased to include the NSERC IRC if the application is successful.

We anticipate that the complete IP agreement will be available for the site visit committee. Broadly speaking, SMART will have access to selected Chair research for non-commercial internal use, and the right to negotiate a licence for particular research results.

Dennis Salahub

Form 101 - Application for a Grant

Intellectual Property

Agreement between SMART and University of Calgary

Proposal for Establishing the
NSERC/iCORE/Smart Technologies Chairs in Interactive Technologies

Prepared by the University of Calgary

1. Chair Rationale

This proposal for a shared Chair in Interactive Technologies stems from five key factors.

The Importance of the Research Area to the University of Calgary. As interactive information technologies become an increasingly important part of everyday life, the task of envisioning new technologies and designing effective interfaces that truly support human activity assumes strategic significance. Human Computer Interaction (HCI), the discipline that investigates interactive technologies, has been a long-standing strength at the University of Calgary. While many institutions have recognized its importance only in the last decade, the University had faculty working in this area since the 1970s. We now have 3 research professors in Computer Science working directly within it. Full Professor Greenberg has been here since 1991; Associate Professor Carpendale arrived in 1999, and recent hire Assistant Professor Sharlin began in 2004.

This proposal is to develop an Industrial Research Chair in Interactive Technologies at the University of Calgary in conjunction with Smart Technologies, Inc. of Calgary (SMART). Additional support would come not only from NSERC, but through the Alberta Provincial Government through its Informatics Circle of Research Excellence (iCORE) Industrial Research Chair Program. The primary goal of the Chair is to design, develop and evaluate interactive technologies so that they support the everyday-world practices of how people view, represent, manage, and interact with information and how they collaborate with it. In particular, the proposal focuses on two themes: ***interactive visualization***, which investigates the possibilities the digital world affords for peoples' exploration of dense and complex information spaces, and ***embodied interaction***, which considers how the technology that displays this information can be designed as a truly integral part of the real world environment. The Chair leverages two excellent in-house candidates as co-chairs – Drs. Greenberg and Carpendale – and the close relationship that already exists between Smart Technologies, Inc., the University of Calgary, and the proposed Chair candidates. It also leverages the recent creation of an iCORE / Smart Technologies Inc Chairs in Interactive Technologies, where this NSERC IRC is for funds matching the industrial contribution of the iCORE Chair. Details are described below.

One of the strategic academic priorities identified in the Academic Plan of the University of Calgary is "Creating Technologies and Managing Information for the Knowledge Society." The priority stipulates that solutions are required in today's world for more effective methods of transmission and analysis of information. The proposed IRC is very well aligned with this priority, in that new technologies will be designed and developed that will facilitate the effective use of the large amounts of information that we are all now confronted with on a daily basis.

The excellence of two in-house candidates and their laboratory. Dr. Greenberg is an internationally renowned expert and senior researcher in Human Computer Interaction and Groupware. Dr. Carpendale is a rising star who has made very significant contributions in Information Visualization and Large Digital Displays. Their significant accomplishments should be evident from their P100s. Together, they have formed the Interactions Laboratory, an extremely strong research group that now includes another faculty member (Dr. Ehud Sharlin), many graduate students, post-docs, visiting researchers and interns. Collectively, this laboratory is considered an internationally recognized powerhouse. Locally, it has become a showcase for the University to illustrate state of the art concepts in Computer Science.

The headquarters of Smart Technologies, Inc. in Calgary. SMART is both an industry pioneer and market leader in versatile, intuitive group collaboration tools, including interactive whiteboards, multimedia furniture, whiteboard capture systems and software. Headquartered in Calgary, Alberta, Canada, SMART also has offices in Japan, Germany and Washington, DC. It currently distributes to more than 65 countries around the world. Its products are innovative, where it pushes the envelope of what can be achieved with large displays. It thus invests heavily in internal research and development, and actively monitors what is being produced by a variety of university laboratories both within and outside of Canada.

The strong existing relationship between the proposed Chairs and Smart Technologies, Inc. Drs. Carpendale and Greenberg have a long-standing relationship with SMART. This began at a grass-roots level over a decade ago between Greenberg, David Martin (the SMART CEO) and Taco Van Ieperen (then the Chief Scientist at SMART). The relationship led to: regular equipment donations by SMART (typically of large SMART Boards) for research use, NSERC Industrial Scholarships with a student interning at SMART, presentations by Greenberg/Carpendale to SMART, hiring of their students by SMART after graduation, and so on. SMART's involvement with Greenberg and Carpendale was formalized three years ago, where SMART became a major industrial sponsor (along with Microsoft, Inc.) of an NSERC Research Networks Grant. Carpendale also worked closely with SMART to design a new high-resolution digital touch table, which is influencing a new product line at SMART. A hallmark of their relationship is mutual respect and reasonable co-expectations: both recognize the interplay of long-term research as done within the University with the shorter-term product research as done within SMART. SMART is currently relocating its headquarters next to the University of Calgary, and we anticipate this will further increase the ties between the University and SMART.

The recent creation of an iCORE / Smart Technologies Inc Chairs in Interactive Technologies. As of September 2007, Alberta's Informatics Circle of Research Excellence (iCORE), created an industrial chair for Carpendale and Greenberg, with Smart Technologies, Inc. being the industrial sponsor. SMART is contributing $500,000 (100K / year for 5 years), which is being matched by iCORE for a total of a $1,000,000 endowment. SMART has also committed to $25,000/year of in-kind support. If the NSERC IRC is awarded, iCORE will further match the NSERC contribution, raising the total endowment to $2,000,000.

The timing of this NSERC IRC could not be better. If awarded, the IRC will leverage the existing long-term collaboration between Greenberg, Carpendale and Smart Technologies, Inc. into a Canadian powerhouse of theoretical and applied research in Interactive Technologies.

2. Description of Position

The Chair itself will be shared by two internal candidates proposed as a Senior and an Associate IRC. Through the use of freed up salary and an iCORE contribution, the Chair will be augmented by two new faculty positions. One hire will be directly within the IRC area, while the other will be in an area in Computer Science complimentary to the IRC research area.

Senior IRC. Dr. Greenberg is a tenured Full Professor within the Department of Computer Science. As evident in his P100, he is also a senior and highly respected international researcher in his field. His most recent service appointment was Graduate Director, where he oversaw the administration of ~170 graduate students in the Department of Computer Science. The University has recently recognized his research excellence by awarding him a University Professorship, which comes with teaching and administrative relief (~ ½ load). The University has also nominated him for a Killam Research Fellowship, and is awaiting results of that competition.

Associate IRC. Dr. Carpendale is a tenured Associate Professor within the Department of Computer Science. As evident in her P100, she is a rising star who, in spite of being on faculty since only late 1999, is highly productive and is also considered a senior international researcher in her field. She holds a Canada Research Chair in Information Visualization jointly in the Faculty of Science and the Faculty of Communications and Culture. This also comes with teaching and administrative relief (~ ½ load). She is the recipient of several major awards including an NSERC UFA and the British Academy of Film and Television Arts Award (BAFTA) for Off-line Learning.

New hire: Assistant Professor, Human Computer Interaction. This new tenure-track hire in Computer Science will directly complement the skills of Carpendale and Greenberg. Expertise will be within human computer interaction, specializing in a mix of information visualization and ubiquitous computing. Space constraints permitting, the hire will be situated within the Interaction Laboratory, thus creating a laboratory of four co-located faculty in Human Computer Interaction. Drs. Greenberg and/or Carpendale will be members of the hiring committee, where they will have significant input on this hiring decision.

New hire: Assistant Professor, Software Engineering / Games. This new tenure-track hire in Computer Science will augment the software development activities of Carpendale and Greenberg. Expertise will be within Software Engineering and / or Games, where the hire's skill set will ideally include methodologies related to requirements analysis, design, implementation and evaluation of ubiquitous computing environments. An expected spin-off is that this hire will strengthen the existing research relationship between the Interactions Laboratory and the Software Engineering Laboratory. Drs. Greenberg and/or Carpendale will inform the decisions of hiring committee concerning this position. In anticipation of the IRC, this position is now being advertised.

3. Use of Released Funds

If awarded, NSERC is expected to contribute $100,000 / year for five years. A portion of these funds will be used to partially replace the salary of Dr. Greenberg, the Senior IRC, with the balance going towards the research program. The released funds, in combination with a further funding match by iCORE, will sum to $100,000 and this will be used in its entirety to directly fund the new Assistant Professor in Human Computer Interaction.

The University will further contribute to the chair in several significant ways.

Supplemental funds for the Assistant Professor in Human Computer Interaction (new hire). The freed up funds will not suffice to fully fund a new position. The University will make up this shortfall (e.g., startup funds, salary overhead differences).

Fully funding the Assistant Professor in Software Engineering / Games (new hire). Similarly, the University will cover the full costs of the other Assistant Professor new position associated with the Chair, i.e., in Software Engineering / Games.

Tenure track. All positions are tenure tracked, where the University will assume their financial obligations after the IRC funding period (although IRC renewal will be anticipated).

Resources. All resource expenditures – space, equipment, furniture – typically accompanying new hires will be assumed by the University. Resources will be provided as expected for any new hire.

While not a contribution of the University, the additional matching of NSERC's contribution by iCORE ($500,000 total) will significantly affect Carpendale and Greenberg's ability to attract and fund high quality graduate students and other HQP.

Incrementality. The primary driver in creating these two new positions is to complement the existing expertise in Human Computer Interaction by creating a new Chair program. The researchers as a group will have the expertise and necessary critical mass to implement innovative methods in Interactive Technologies that can not only influence how people use technology, but that strengthens Canadian industries who are producing these technologies and that trains the HQP necessary to staff these industries.

4. Research Capacity.

The University of Calgary is a major research university, comprised of many academic units, with a total enrollment of about 28,000 students (undergraduate and graduate). The enrollment is expected to increase to about 35,000 by the year 2010, thanks to support from the Government of Alberta and Alberta's economic growth.

Drs. Greenberg and Carpendale currently run the Interactions Laboratory in the Department of Computer Science, a well-equipped research laboratory consisting of three large interconnected rooms used by about 20 researchers, including Drs. Greenberg and Carpendale, a third faculty member, graduate students, post-doctoral fellows, and other researchers (including visiting scientists). Each researcher has a furnished individual work space which includes a workstation. The lab also contains vertical displays and interactive table-top displays. Additional rooms attached to the laboratory include a library room, a breakout room, and six offices (three for faculty and three for post-doctoral researchers and visiting scientists). The team also has access to a departmental seminar room, and to the other computing facilities that are generally available to all department members.

Regarding the additional equipment to be acquired from the IRC funds, and the two new assistant professors that will be hired if this IRC application is successful, it is expected that they will be accommodated, in the near term, within the existing facilities in the Department of Computer Science. However, two new buildings are in the planning stages for the University of Calgary campus, and are slated for completion in about 2010. Plans for the usage of this additional space are not yet complete, but it is conceivable that additional space and facilities could be made available to Drs. Greenberg and Carpendale and their research team, depending on the outcome of the planning process.

As indicated in the Budget Justification part of this application, the University will cover the majority of the chair salaries. Any funds that are freed up, due to the awarding of the NSERC IRC, would be used to partially fund two new positions that will support the IRC.

The University, and the Department of Computer Science, are well prepared to support this IRC with the funds and facilities that are required to make it a success.

5. Anticipated Impact.

The anticipated impact of the IRC lies in several areas.

- It will make the University of Calgary a world leader in Human Computer Interaction research and education, and as a consequence will attract first class researchers and graduate students from around Canada and the world.
- It will enhance the already strong research groups surrounding Human Computer Interaction,
- It will formalize and strengthen the existing links between Human Computer Interaction and Software Engineering,

- It will promote more direct interaction between the University and Smart Technologies, Inc.

Human Computer Interaction (HCI) is already a recognized strength of the University of Calgary: the Department of Computer Science now includes HCI within one of their five primary research themes. In particular, Visual and Interactive Computing is a synergy of three HCI faculty (Carpendale, Greenberg and Sharlin), four Graphics faculty (Costa Souza, Gavriola, Prusinkiewcz, and Samavati), and a Computer Vision faculty (Boyd). Calgary is already considered an international leader in this area. The IRC Chair emphasis on Interactive Technologies, alongside the new hire, will further strengthen this group and its prominence in the field.

The other associated new hire in Software Engineering / Games will strengthen the bonds across groups. The Software Engineering and the Interaction Laboratory are already interacting on several related projects; we anticipate the new hire will lead to more direct, targeted research between them.

Smart Technologies, Inc. is a major industrial player in Information and Communications Technology (ICT) in Alberta. While a medium-sized industry (~1000 people and growing fast), it is well known in Canada as an innovative creator of new technologies. SMART's co-founders David Martin and Nancy Knowlton are its CEOs, and both have a keen interest to work with the community around them. They have a long history of interaction with the University, where both have actively sought for productive ways to strengthen the bonds between them. Specifically, they have worked directly with the Chair candidates both informally and formally. Smart Technologies, Inc.'s support of the NSERC Research Network Grant (involving both Carpendale and Greenberg) and more recently of the iCORE / Smart Technologies Chair in Interactive Technologies (with Greenberg/Carpendale as the co-Chairs) are two very strong indicators of the bonds between them. As a medium-size company, their financial commitment of 500,000 to the Chair is significant. The IRC, if awarded, will serve as a strong multiplier of this contribution.

6. Intellectual Property

The University of Calgary has standard guidelines in managing and dealing with intellectual property that results from NSERC and industrial sponsored research programs. There is now a detailed Intellectual Property Agreement in preparation between the University of Calgary and Smart Technologies, Inc., as part of the arrangements for the iCORE / Smart Technologies, Inc. Chair – the terms are in keeping with our standard guidelines. Broadly speaking, the agreement makes provision for the protection of intellectual property (IP). SMART will have access to the Chair research for non-commercial internal use, and the right to negotiate a licence for selected research results.

University Technology International, Inc. (UTI), a wholly owned subsidiary of the University of Calgary that assists researchers with technology transfer, will be contacted to handle the potential patents or other commercialization issues and questions.

Section II: Detailed Research Proposal

NSERC/iCORE/Smart Technologies Chairs in Interactive Technologies

Prepared by Greenberg / Carpendale, the Chair Candidates

1 Synopsis

1.1 Areas of Research

The proposed IRC Chairs, who are equal partners in this application, will conduct research within the Computer Science / ICT (Information and Communications Technology) area of *Interactive Technologies.* In particular, the research includes the Computer Science sub-disciplines of Human Computer Interaction, Information Visualization, Ubiquitous Computing and Computer Supported Cooperative Work.

1.2 Summary of the Proposal

Modern society demands that people manage, communicate and interact with digital information and digital devices at an ever-increasing pace. While a crucial part of people's everyday lives, most find today's technologies awkward and stressful to use, and overly intrusive in their lives. The problem is not with the information itself, but rather with its sheer volume and the unwieldy ways now provided to present, exchange, view and interact with digital content. The Chairs will attack this problem, with the overall objective to:

> "*design, develop and evaluate interactive technologies so that they support the everyday-world practices of how people view, represent, manage, and interact with information and how they collaborate with it."*

This broad objective is realized by two inter-related research themes. First, ***interactive visualization*** investigates the possibilities the digital world affords for peoples' exploration of dense and complex information spaces. The overall goal of an effective interactive visualization is to promote comprehension by providing people with appropriate interactive technologies and digital displays that help them transform information into knowledge. Second, ***embodied interaction*** considers how the technology that displays this information can be designed as a truly integral part of the real world environment. The overall goal is to create new interactive displays and computational devices that fit, support and participate in – rather than ignore – the everyday-world social practices of people and their surrounding environment. Both themes are tightly intertwined: Interactive visualization considers the fundamental nature of information and how people can effectively interact with it through technology, while embodied interaction considers how these technologies manifest themselves in ways that exploit the everyday practices and routines of people.

As Chair partners, Carpendale and Greenberg's combined expertise, along with their well-equipped laboratory and flourishing group of researchers and graduate students, will leverage one another's abilities to reconsider novel designs of interactive technologies. This laboratory, along with the hiring expansion partially permitted by IRC funding, will position the University of Calgary as one of the world leaders in Human Computer Interaction. Smart Technologies, Inc. manufactures large touch-sensitive displays and associated software, and their technology suggests new ways for people to interact over information and with each other. As an industrial sponsor, the work of Smart Technologies, Inc. (SMART) creates a new opportunity in how the Chairs consider interactive technologies. Smart Technologies, Inc. also serves as a Canadian industry receptor that can potentially capitalize on the Chair research.

1.3 Supporting Organizations

The Chair partners will be supported by the University of Calgary, by Smart Technologies, Inc. as the single industrial sponsor, and by iCORE through an existing iCORE Industrial Chair currently worth $1,000,000 over five years. Letters from all organizations are attached. This NSERC IRC application is a request to further match the Smart Technologies, Inc contribution for a further $500,000. If awarded, iCORE will again match the NSERC contribution, thus leading to a total endowment of $2,000,000 across the NSERC IRC and iCORE chair.

Smart Technologies, Inc. is both the industry pioneer and market leader in versatile, intuitive group collaboration tools, including interactive whiteboards, multimedia furniture, whiteboard capture systems and software. Headquartered in Calgary, Alberta, Canada, SMART also has offices in Japan, Germany and Washington, DC. It currently distributes to more than 65 countries around the world. SMART has just begun construction of a new building to house its headquarters next to the University of Calgary.

The University of Calgary is a comprehensive research university that, in its short 41-year history, has grown to take its place among the finest institutions in Canada. Combining the best of long-established university traditions with the City of Calgary's vibrant energy and diversity, the university aims to provide a research and scholarly foundation for students eager to acquire the knowledge and skills essential for a successful personal and professional life. Within the University, Computer Science is a thriving research department with 45 full time faculty ~150 graduate students, and world class facilities.

iCORE – the Informatics Circle of Research Excellence – was established in October 1999 by the Government of Alberta to foster an expanding community of exceptional researchers in the field of informatics. iCORE is directing its support to areas in which Alberta has a chance to develop internationally recognized research teams. It is also focusing on areas in which Alberta companies are active, so that intellectual property and valuable knowledge workers resulting from iCORE's investment will have compelling reasons to stay in Alberta. It operates several grant programs to develop iCORE Chairs at Alberta universities, around which world-class research teams are developed.

2 Interactive Technologies Research Proposal

Modern society demands that people manage, communicate and interact with digital information and digital devices at an ever-increasing pace. Indeed, many types of computer tools are now considered essential in our everyday lives for working, playing, communicating, learning, socializing and otherwise interacting. Although most people do benefit from these digital technologies, using them is frequently awkward and stressful to use, and overly intrusive in their lives. Terms like “information overload”, “hard to use”, “disruptive”, “time-wasting” and “overly complex” are now commonly associated with digital technology.

The problem is not with the information itself, but rather with its sheer volume and the unwieldy ways now provided to present, exchange, view, interact and collaborate with it. The proposed NSERC IRC co-Chairs attack this problem, with the overall objective to:

> *“design, develop and evaluate interactive technologies so that they support the everyday-world practices of how people view, represent, manage, and interact with information and how they collaborate with it.”*

This broad objective is realized by two inter-related research themes. Theme 1 is ***interactive visualization***, which investigates the possibilities the digital world affords for peoples’ exploration and manipulation of dense and complex information spaces. The overall goal of an effective interactive visualization is to promote comprehension by providing people with appropriate interactive technologies

and digital displays that help them transform information into knowledge. The visualization research community increasingly recognizes that an effective information display must be aesthetic (to reveal the underlying value of the information) and interactive (so that people can bring all their senses into play to help them understand and manipulate the intricacies of the information).

Theme 2 is ***embodied interaction***, which considers how the technology that displays this information can be designed as a truly integral part of the real world environment. We are not talking about 'prettying up' the desktop computer. Rather, our overall goal is to create new interactive displays and computational devices that fit, support and participate in – rather than ignore – the everyday-world social practices of people and their surrounding environment. The challenge is how to completely redesign computer appliances so that they become an integral part of the everyday environment and social practices of the people who use them. Success occurs when people use these systems to pursue and maintain their everyday activities and collaborations within their real world context.

These two themes, described in more detail in Sections 2.1 and 2.2, are tightly intertwined. Interactive visualization considers the fundamental nature of information and how people can effectively interact with it through technology, while embodied interaction considers how these technologies manifest themselves in ways that exploit the everyday practices and routines of people. Both use the same research methodological approach to research, as described in Section 2.3.

The proposed Chair partners and industrial sponsor are ideal for this venture. Greenberg and Carpendale currently run the Interactions Laboratory within the University of Calgary, which defines a thriving community of graduate students and other researchers. Dr. Carpendale is expert in information visualization and large display technologies, while Dr. Greenberg is expert in social and technical aspects of collaborative technologies and context-aware computing. Both have synergistic research projects and skills. As Co-Chair partners, their combined expertise will leverage one another's abilities to reconsider novel designs of interactive technologies. Smart Technologies, Inc. manufactures large touch-sensitive displays and associated software, and their technology suggests new ways for people to interact over information and with each other. As an industrial sponsor, the work of Smart Technologies, Inc. creates a new opportunity in how the Chairs consider interactive technologies. Smart Technologies, Inc. also serves as a Canadian industry receptor that can potentially capitalize on the Chair research.

Note: *The milestones specified in the activity schedule are provided at a fairly broad level. This is because this proposal is best seen as describing a research agenda vs. particular research deliverables. While outcomes for the first few years are known, we expect activities after year two to be shaped significantly by our early outcomes, as well as the directions taken by incoming HQP.*

2.1 Theme 1: Interactive Visualization

Interactive Visualization develops methods that help people access, explore, comprehend, use and manipulate rich digital information. Our basic approach involves developing visual representations and discovering methods that support interactive exploration of these visual representations.

> The power of the unaided mind is highly overrated. Without external aids, memory, thought, and reasoning are all constrained. But human intelligence is highly flexible and adaptive, superb at inventing procedures and objects that overcome its own limits. The real powers come from devising external aids that enhance cognitive abilities. (Norman, 1993 [33])

Background. Terms like information society, information overload, information explosion, and information anxiety have become common place. We are generating information at an ever increasing pace and yet, even though most people want to be informed, all this information is frequently experienced as stress. It is not the information itself that is the problem, but the manner in which we are

bombarded with information in a form that is often hard to interpret and manipulate. In this theme, our research agenda is to produce interactive visualizations of digital data that enhances people's cognitive abilities. These visualizations not only present information visually and aesthetically, but provide people with capabilities for manipulating and exploring this information. A good visualization provokes interpretation, exploration and appreciation, inviting direct interaction that reveals the data contents [7, 8, 33, 42].

Presenting information visually is so closely linked to our notions of understanding that colloquially the verbs 'to see' and 'to understand' are often interchanged. This notion is driving a demand for effective visualizations, and given current trends this will increase to the point where information visualization will be ubiquitous. Information visualization is becoming an indispensable tool that supports many tasks such as information retrieval, decision-making, data mining, and collaborative exploration [8].

Interactivity or providing capabilities for manipulation and exploration of information is just as important as making it visible [7, 8, 33, 42]. We wish to create information environments where people can interactively explore information, stretching regions of interest with actions that allow visual exploration but leave one confident that the information they are exploring remains consistent. We will explore new interaction methods to better support exploration and manipulation of dense and complex information spaces, working towards promoting comprehension by providing appropriate interactive technologies that address turning information into knowledge. Research has shown that both adults and children develop new insights through information manipulation [9], and it is this deeper understanding that we wish to enable.

Originally, to visualize meant to create an internal mental image. In terms of computers, to create a visualization is to create an external representation, which can be displayed and manipulated on a computer. There is growing evidence that the ability to externalize information, particularly in visual form, can be of considerable aid to insight and thought processes in general [8, 43]. As visualization research has progressed the focus on interactivity has increased. As early as 1983, Bertin [7] declared that viewing a visualization was just one step in the process of making a decision. Spence notes that interactivity is important because "the mere rearrangement of how data is displayed can lead to a surprising degree of additional insight into the data" [p.14, 42].There are now design guidelines that call for interactivity (34), and definitions that include interactivity as fundamental [8].

Recently, a widely accepted report titled 'Illuminating the Path' [44] suggested that it is important to consider working with information as a process where a visual representation simply sets the stage for a dialog between a person and their data. They identified a grand research challenge: to enable people to make the best use of their information – even if it is incomplete or inconsistent – in support of their decisions so that they can "detect the expected and discover the unexpected" [44] thus enabling profound insights. Their identified challenges include: data representations and transformations, supporting analytical reasoning, and collaborative visual analysis. Our theme 1 projects relate strongly to this challange. Both visualizing uncertainty and interactive information exploration are important aspects of data representations and transformations. Visualizing uncertainty and visual decision support are necessary for supporting analytical reasoning. Social visualization and creating visualizations that support collaboration are part of developing collaborative visual analysis tools.

The following research objectives narrow in on particular sub-projects in this theme; additional background is provided within them. These projects are samplings, as we expect new projects will emerge out of our research discoveries during the Chair period.

Research Objectives. Interactive visualization investigates the possibilities the digital world affords for people's exploration of dense and complex information spaces. The overall goal of an effective interactive visualization is to promote comprehension by providing people with appropriate interactive

technologies that transform information into knowledge. The visualization research community increasingly recognizes that an effective information display must be aesthetic (to reveal the underlying value of the information) and interactive (so that people can bring all their senses into play to help them understand the intricacies of the information). It is in aesthetic interactivity that we can explore the grand challenge of visualizing abstract concepts like causality, temporality, and uncertainty.

Our long term objective in this theme is to:

> *Design, develop and evaluate interactive visualizations of information that address some of people's challenges as part of an information society and to enhance their cognitive and communicative abilities: to see the invisible, to comprehend vast information spaces, to manipulate abstract concepts, to appreciate the beauty of information structure, and to support decision making and collaborative processes. Interactive visualizations are successful when they can help people interpret and understand information, steps which are integral in our processes of developing knowledge.*

Example Sub-goals and Projects. An illustrative sampling of projects arising in this theme is listed below. Some are in progress, while others are new. Others will emerge from our research discoveries.

1. *Visualizing Uncertainty.* Data nearly always has some type of associated uncertainty, perhaps due to inaccuracies in data collection methods, or probabilities associated with data generation (such as simulations), or because the data may represent only one of many potential outcomes. Understanding uncertainty is important if the person viewing the visualization is to have appropriate confidence in their interpretation of it. The need for visualizing uncertainty along with its associated data now has widespread acceptance and has been recognized as a significant challenge in information visualization [35, 44]. Yet integrating uncertainty into a visual representation while maintaining ease of comprehension is not straight forward and remains a significant research challenge. Indeed, most existing information systems leave it out; there are currently only a few examples of such visualizations, e.g., vector direction uncertainty [51], molecular positional uncertainty [35], and data quality in Geographical Information Systems [27, 65]. The goal of this project is to determine what visual representations can be provided, and how interaction can enable people to understand and manage uncertainty effectively. Such development of new representations and innovative visualization frameworks is fundamental to increasing the understanding of data with uncertainty. Our research to date has focused on developing methodologies to best take advantage of general information visualization knowledge to assess and design uncertainty visualizations, e.g., [SC19, SC49].

2. *Visual Decision Support.* Effective information visualization lets people naturally access and interact with their data during their decision making processes. Others have already argued that a good representation not only reveals the problem but also suggests at the solution [33], but the challenge is how to design such representations. As a beginning, Amar and Stasko [1] introduce steps to be taken to build better visualizations and thus better visual decision support. Their suggestions include representation flexibility, revealing uncertainty, and decreasing the gap between what can now be presented visually *vs.* what needs to be available visually. Our particular motivation in this project is to consider visual decision support to help manager the current devastating outbreak of mountain pine beetles (MPB) in the interior of British Columbia. Many efforts are being taken to get a better understanding of the beetle's behaviour, to predict future impact, and to provide forest managers with information upon which they can base their decisions regarding the beetles. As part of these efforts, complex simulation models [17] of MPB activities on a landscape scale are being created. These simulations combine typical forest patterns and MPB distribution patterns on a landscape scale and, under different conditions, to simulate various MPB management strategies. The goal is – through interactive visualization of simulation results – to create methods which identify efficient management strategies for a given type of landscape pattern and a set of applied conditions, e.g.,

[SC12]. Our methodology is to work closely with the decisions makers using established methods as described in Section 2.3. As this work matures, we will then apply our visual decision support experiences to other domains, including command and control situations and diagnostic decision processes.

3. *Accessing Information Details.* Computers are more and more frequently being used to explore and drill down into vast information spaces. Yet information drill-down continues to present many challenges. This can be because of the shear scale of the information means one can get lost in the information space [48], or the loss of global context as one zooms into details [7], or the loss of resolution if that information detail is not available (e.g., fat pixels), or the amount of different related pieces of information that ones needs to work with at one time on an inadequate screen space [48, 45]. Tools necessary for this type of exploration need to let people organize, categorize, compare and access appropriate details when needed. Solutions to these problems are under active investigation [8, 42]; techniques include zooming methods [6], nonlinear based methods [20, SC39, 26], and, more recently, interactive combinations of these [11]. Variations of these methods are also being developed for new technologies such as wall displays [4], and tabletop displays [19, SC25]. Our research goal addresses the issue of providing access to additional detail when zooming into data on computers. Magnification is only one of many possibilities. We will also explore setting semantically related data in context. Such semantic zooming adjusts the information detail, its visual form, and integration to related information to best fit the zoom level. For example, if one has a map of a city and one places a semantic lens on it, one could zoom into detail about the water and sewage pipes below the city. Other directions include supporting human potential for visual gestalt [48], reducing cognitive effort needed for the re-integration of information across separate views [7], addressing navigational problems by accessing spatial reasoning [48], and using visual cues to provide meta-information about the interactions [SC42, 43].

4. *Social Visualization.* Social visualization codifies and visualizes the social interactions of people. This includes visualizing internal team communications, visualizing organizational contact patterns, etc. One example is that for people interacting online, much of the richness of face-to-face social interactions is missing, and thus people have a weaker sense of the social fabric that creates the group. This problem motivates the rapidly expanding research area of computer visualization of social data. Examples include: social networks [13, SC38], email messages [25], and instant messaging chat activities [47, 16, SC20], and internet communities formed around systems such as Flickr, MySpace, and YouTube. Our goal is to explore the possibility of creating visualizations of the meta-data that exists in online interaction and seeing whether it will be possible to use this to visualize and enrich our online interactions and information exchanges. Our current work on social visualization is generating considerable interest [SC20, SC6, SC7, SG80, SG75, SG53] and has expanded to include contacts in computational linguistics (with Dr. Penn, University of Toronto), and explorations in visualizations to aid in computational linguistic research. Another research thread we are pursuing includes how people maintain relationships in non-work environments, e.g., the home [SG19, SG27, SG14] and between friends [SG20, SG29].

5. *Collaborative Visualization.* Practical use of visualizations often involves small teams of scientists working together over the visualization to discover the insights available in their data. Yet most computer visualizations are designed for a single person rather than collaborators working together. While there has been a strong call for collaborative visualization tools from both academia and industry [44], little research has yet been done. Exceptions include some tabletop display research [46, 19], and the commercial Comotion [29] system that offers some visualization support for both distributed and co-located collaborators. Our goal is to explore collaborative information visualization. In particular, we want to develop interactive information visualization tools for both collocated and distributed collaborators. To date our research has focused on fundamental issues such

as understanding the collaborative processes [SC2, SC3, SG15, SG43. SG79] and requirements for increased and new types of interaction that can better support collaboration, e.g., [SC25, SC18, SG3, SG9, SG21, SG31]. We are now creating an information exploration environment that is specifically designed for two or more collocated people who are actively collaborating.

While Theme 1 considers the essence of information visualization, Theme 2 addresses how people use, interact and collaborate with and through information in the every day world.

2.2 Theme 2: Embodied Interaction

Embodied interaction situates computer-supported information and social interaction in the real world context to facilitate natural social practice [14]. Our basic approach involves understanding social practices, and then designing, implementing and evaluating technologies and infrastructures to fit within particular environments and contexts of use.

> The idea of disembodied rationality … arises because we think about cognition only in those immediately apparent problem cases where some problem appears in the world that needs to be solved. This ignores 99% of our daily lives, the mundane everyday existence in which we simply go our about business. [An alternative approach] explores our experiences as embodied actors interacting in the world, participating in it and acting through it, in the absorbed and unreflective manner of normal experience. [14].

Background. People's use of computers is expanding dramatically beyond their traditional role as tools supporting individual productivity work. We are now seeing a grassroots adoption of computers as the media of choice for interpersonal communication, for informal information creation and sharing, for leisure, and for entertainment [3]. The computer is becoming part of the living fabric of everyday life. As a consequence, its form is shifting: ubiquitous information appliances are replacing desktop machines [49], e.g., large displays, iPods, digital cameras, cell phones, GPSs and PDAs. Behind each 'gadget' genre are large (often multi-billion dollar) support utilities that make these devices useful in practice: entertainment delivery, music purchasing, photo exchange services, wireless communications infrastructures, satellite positioning, and so on [15]. Almost all these new uses support some degree of social interaction, e.g., by creating opportunities for easy collaboration (large displays), by information exchange (photos, music), by direct communication (voice, video, text messaging), by being aware of others (buddy lists). Yet this new generation of ubiquitous computers and devices are still notoriously awkward [15, 37]. As Yvonne Rogers writes: "There is an enormous gap between the dream of comfortable, informed and effortless living and the accomplishments of Ubiquitous Computing research" [p405, 37]. Consequently, our overall goal is to redesign computers to gracefully fit these new social settings and uses.

For example, consider people interacting over a physical table. A person can easily organize artefacts atop of it. Passer-by's can see what is on the table, and can progressively engage into the tabletop interaction by how they stand and/or sit around it. Communication and interaction is easy: people naturally gesture over the table, manipulate artefacts upon it, and use space as needed. Mutual and subtle signals are exchanged, and conversation ensues. The surrounding physical context defines who can monitor the activity, and what nearby resources and other surfaces can be brought into the conversation. Its culture of use establishes how things can be left atop of it over time, and how others are permitted to manipulate its contents. This is *Embodied Interaction*, as defined by Dourish [14], where interaction and collaboration leverage our physical presence in the real world and are socially embedded within our real world practices and purposes. Fundamental to this notion is that people's collaborative activity participates in the real world rather than stands apart from it. In contrast, the current model of computing

is the antithesis of embodied interaction. The small screen of the desktop computer and its location typically inhibit collaboration simply by the way people's bodies shield the displays from view. Even when encounters are started, people need to jockey for space around the screen. Input is unsatisfactory, as the single mouse and keyboard does not allow for simultaneous activity. Bringing in real-world information – no matter how relevant – is excessively difficult, even if it is digitally available on (say) a nearby PC or PDA. Login accounts also inhibit cultural evolution; a group cannot easily create a cultural artefact because it is locked into someone's private space. What has happened is that the computer is forcing people to collaborate on its own terms, and as a result entirely ignores the deep social context that defines human-human interaction [10, 14, 18, 37]. Consequently, various movements in human computer interaction are seeking alternative approaches to interaction design, e.g., ubiquitous computing [15,37,49], tangible computing [24], context aware computing [30], physical user interfaces [SG77, SG82], information appliances [34], and so on.

Research Objectives. In this research program, we take the different tack of leveraging embodied interaction theory [14], where we apply it to interactive technologies and groupware design. We investigate the human factors of how people work together in their natural context [28], we operationalize these as interactive technologies, we evaluate how these new technologies affect people's behaviour, and we generalize results as design-oriented principles and theories. In this proposal, we envision technologies appropriately embedded within our real world context to facilitate natural social practice.

Our long term objective in this theme is to:

> *Design, develop and evaluate interactive technology so that it supports and participates in – rather than ignores – the everyday-world practices of people. Social groups will use these systems to pursue and maintain their long-term collaborations within their real world context.*

Similar to Theme 1, the following research objectives narrow in on particular sub-projects in this theme; additional background is provided within them. These projects are just the start, as we expect new projects to emerge out of our research discoveries.

Sub-goals and Projects. We will focus on specific project domains, four of which are listed below, where we will design, implement and evaluate technologies to fit within particular environments and contexts of use. We will target closely-knit groups of collaborators who work within several particular settings and who are pursuing particular social activities.

1. *Understanding social practices.* The design of software supporting embodied interaction must be founded upon a deep understanding of the role and affordances of the everyday physical environment, the social collaborative practices of people within them [2, 10, 14, SG76], and the opportunities available for supporting social practice with technology [30, 34]. This user and social-centered requirements analysis will, in turn, indicate the general design parameters, essential features, and components – the design rationale – of our embodied technologies. This approach contrasts with mainstream software engineering and HCI requirements analysis, which is usually focused narrowly on task and needs analysis [40, 32, SG78]. However, the idea of beginning with social practices is now fundamental to most new ways of thinking of human computer interaction. Several comprehensive theories are also emerging from these studies, including the Locales Framework [18], and Embodied Interaction [14]. Our goal is to identify essential design criteria, empirical principles, and theories for embodied interaction that lead to effective, efficient, satisfying and safe collaborations within particular settings. Domains of study include understanding:
   - how collaborators work over both physical and electronic shared visual work surfaces, e.g., [SG5, SC2, SC31, SG9, SG15, SG31]

- how people work through cognitive processes such as creation, self expression, reasoning, and diagnosis [SC13],
- how people form casual interactions and how they bring their work artefacts into these conversations, e.g., [SG22, SG28, SG29, SG35, SG41, SG79, SG80] and
- understanding how people maintain awareness, communicate and interact within domestic environments [23, SG14, SG20, SG27, SG34] as well as concerns about privacy [2, SG2, SG4].

2. *Collocated and distributed groupware interaction technologies.* The above sub-goal articulates the social practices within particular settings. In turn, these suggest opportunities where we can either create new technologies or improve existing ones that truly support what people do. Our goal is to design and develop groupware technologies firmly based on these social practices, that we embed these into collaborators' physical environments, and that we evaluate how they are used and/or misused. The results feed back into iterative re-design, which will be generalized as empirically-informed design principles. This approach has been used successfully by other researchers, e.g., for building technologies to support extended families [31]. In particular, we will develop and evaluate the following technologies:
   - tools supporting casual interaction, where we will develop media spaces for tele-commuters and light-weight methods for co-located people to monitor information on large displays and move into interaction over them, e.g., [SG21, SG22, SG28]; and
   - a suite of domestic information appliances, which are aesthetically pleasing hardware devices appropriately located in a person's physical environment such that they encourage interpersonal awareness leading to interaction (e.g., [24, SG12, SG14]).
3. *Direct touch interactive large display technologies.* Traditional tables have long been a preferred small group environment for many collaboration tasks. Large computerized displays, such as digital walls and tables, open up many new possibilities for creating more natural work and social environments. Initial ideas about wall and tabletop displays [49, 50], and recent technological advances in hardware, multi-user touch and toolkits [12, DViT SMARTBoard™, 39, SC18, SG32, SG54], have fuelled renewed interest in large display research [41, SC31]. This has resulted in a growing number of wall or tabletop specific interaction techniques [19, 39, 46, SC1, SC8, SG23, SG24]. Unfortunately, collaborating at current digital tabletop displays is still often awkward and frustrating. Some interactivity problems arise simply from scale: on a direct touch large display it may no longer be easy or even possible to reach all areas of the display be it a wall or table. On the other hand, that same size makes it possible for several people to work together on a single display, raising questions of how to support this collaborative activity [12]. Another problem stems from our technologies: current input methods are crude, often limiting what can be done. Our goal is to design and develop individual and groupware technologies that leverage our developing understanding about the intricacies of collaborative, social and creative practices over large digital surfaces. With similar methodology to sub-project 2 we will create novel interactive techniques that carefully consider how to provide natural interactions for various large displays environments. The process will require considerable evaluation and iteratively re-design, where we will work towards generalizing our outcomes as empirically-informed design principles and as new infrastructure for scaffolding future research. In particular, we will develop and evaluate the following technologies:
   - we will develop input methods that are aware of multiple people, and that leverage how people interact and communicate over the surface via gestures and verbal utterances (e.g., [SC2, SC17, , SG23, SG24]), that link geographically distributed surfaces (e.g., [SG5,SG21]), and that capitalize on how people use space (e.g., [SC1, SC14, SC25]);
   - we will create novel interaction techniques specifically design to support two or more people who are actively collaborating (e.g., [SC29]); and

- to enrich interaction with digital tables, we will investigate the concept of shallow-depth 3D – 3D interaction with limited depth. Our focus will be on shallow-depth interaction in the z-plane because interactions on traditional tables take place within a shallow-depth field (e.g. riffling, sorting and manipulating piles, and rotating or flipping objects on the surface) (e.g., [SC8]). We will consider bimanual control and investigate the use of one or more touch points, studying a wide range of 3D interaction possibilities.

4. *Infrastructure for embodied interaction.* Iterative design is fundamental to our methodology (Section 2.3). This in turn requires a solid infrastructure that allows our team to rapidly prototype ideas, to iteratively refine them, and to formatively evaluate these systems by deploying robust working prototypes into appropriate physical settings. Unfortunately, there are few software platforms that afford easy construction and refinement of embodied interaction. Our goal is to design and implement a suite of tools that the entire research team can use to efficiently develop, iterate and evaluate a robust set of embodied interaction prototypes [SG1]. We will generalize, transform and package the software concepts common to our early prototypes into reusable and documented infrastructures and toolkits, and distribute them to researchers as building blocks. In particular, we will develop:
   - A Shared Data Toolkit will let programmers marshal, distribute and manage a variety of information sources. This includes real-time multimedia information (video, audio), data captured from sensors and groupware appliances, as well as more conventional data. This toolkit will significantly reduce the effort of connecting, configuring, and controlling the embodied interaction technologies described above. Specifically, we will begin by merging our own .Networking toolkit [SG26] with a modified version of Gutwin's toolkit that promotes packet compression and quality of service [22].
   - A Shared Physical User Interface Toolkit is a hardware/software toolkit that lets programmers include a set of distributed sensors, actuators, and other physical devices into their physical interface designs, and that lets them distribute control and events of these devices across a network. While we already have one version built [SG42], a distributed version of this toolkit that we are now working on [SG13] will significantly reduce the effort of gathering environmental information and of designing networked appliances [34] within context-aware but distributed groupware settings [30, SG77].
   - Tabletop and Large Display Architecture, which generalize as building blocks how input can be performed effectively over large surfaces, and how output can be efficiently rendered onto very high resolution displays. Resolution is one issue, whether it is from naïvely creating larger low resolution displays by simply stretching our currently common resolution over a larger space, or from creating a high resolution display by tiling many projectors [21, 4]. For output, we will develop high resolution display methods for these surfaces. High resolution surfaces introduce a serious technical problem in that pixel count heavily affects computational interactivity, i.e., the sheer amount of pixels may slow down the rapid image update necessary for fluid, interactive work. Previous approaches have used an array of computers [21] or independent displays linked through software [44]. Our own initial work in this area employs four concepts/techniques: layered buffers, local coherence, emergent complexity, and force fields. These have provided an order of magnitude speed-up [SC18]. Our current goal is to use this proof of concept prototype as a basis from which to design infrastructure for an interaction framework that can be used as a basis for future research.

2.3 Research Methodology

Our development methodology across both themes will follow standard practices in human computer interaction, computer supported cooperative work, and information visualization for participatory and

iterative people-centered design. Evaluation methodologies are drawn from software engineering, usability engineering, human factors testing, and ethnographic approaches [32, 18, 40]. The basic methodological structure is described below.

1. *Observation.* We work from the principle that technology design should be informed by how people manipulate information as they live, work and play. Our design process starts with careful observational studies and participatory designs in which we seek to expand our understanding of what factors would benefit from technological support [28]. This includes details such as how people collaboratively work over information within a visual workspace, e.g., how use their hands [SC2], how people move in and out of close collaboration during team work [SC17], how people talk and gesture as they work together [SG23, SG24, SG25], how theories of general human behaviour such as proximity and territoriality [2] play out in team work and collaborative settings [SC25], how workspace awareness is maintained [SG7, SG9], how people interact within domestic environments [SG19, SG27], and so on.
2. *Task and domain settings.* An important aspect to improving visualization and embodied interaction in general involves developing better understandings of domain-specific problems. People come from many disciplines and settings, and these can have a profound effect on what they need. We will ground our research in specific real world applications where we can focus on specific data people need and use, identify the important features of their information, understand the specific nature of their tasks, and look for factors that arise from their everyday social context and routines.
3. *Invention.* Of course, the various technologies will be developed to fit the current practices of people in a way that matches their task and domain settings. Our basic approach is to follow the standard user-centered design / iterate cycle typical of most research in human computer interaction [32], but augmented by the understandings gained in the above two steps. We will rapidly prototype visualizations, techniques, systems and appliances that reveal not only information content but that will allow us to explore how it fits into people's social practices. Successful outcomes will be generalized and packaged as reusable classes of interaction techniques, toolkits and infrastructures.
4. *Evaluation.* To complete the cycle, all systems will be evaluated as they are being developed. Our basic approach is to use both discount and precise evaluation methods [e.g., 32] as well as qualitative methods [e.g., 28] to allow us to not only validate good designs, but to critique and understand less successful ones. In essence, evaluation allows us to reflect on our technical solutions: to decide what to change in the next iteration, to propose what could serve as effective design principles, and to analyze how our designs would work in practice.

We stress that we are already highly experienced in this 4 step methodology. Indeed, the majority of the papers described in the attached P100s report on work that are direct outcomes of this methodology.

2.4 Synergy of the Chair Applicants

Greenberg and Carpendale are research experts, with considerable experience in the above domains. As evident in their CV's, Carpendale's primary expertise and experience is in information visualization, while Greenberg's is in groupware and ubiquitous computing. Yet both have done considerable work in each other's area. For example, Greenberg created novel visualizations that help people maintain awareness of one another's activities when working together. Similarly, Carpendale has made significant theoretical and technical contributions to our understanding of how people collaborate over tables and how digital tables can be designed. Both now work together closely (and with each other's students) to consider how people interact over information in a social context. Their strong synergy across both proposed themes is a direct result of their complementary and overlapping expertises.

3 Proposed Collaborations.

3.1 Relationships between Co-Chair applicants and other Academic Colleagues

As part of the Chair, the University has committed to two faculty hires.

One hire is within Computer Science, where the position is targeted for Human Computer Interaction. Specifically, the Chair applicants will be members of the hiring committee, and will look for skills relating to one or both themes proposed above. We anticipate that this hire will work directly with the Chairs on a daily basis, where he or she will (space permitting) share their laboratory space and equipment.

The second hire is also within Computer Science, where the position is targeted primarily for Software Engineering, and / or possibly Games. Specifically, the search committee will look for candidates in one or both of these areas that have a background that overlaps with Human Computer Interaction. Ideally, the hire will have skills relating to requirements analysis and evaluation of both conventional interactive technologies and to applying them to ubiquitous computing environments. We anticipate that the hire will reside in the Software Engineering / Games group, but will interact regularly with the Chairs on the various projects defined in this proposal (e.g., by direct involvement, by student co-supervision, etc.). As a side effect, we anticipate that this hire will further strengthen research synergies that already exist between the HCI and Software Engineering / Games group.

Of course, both Greenberg and Carpendale already have many existing collaborations with other Canadian HCI researchers; many of these were formed during the NSERC Research Networks grant, and have already led to joint projects and publications that inspired this proposal. The Chair position will free up sufficient funds to allow them to fund modest travel between these University laboratories, where they can conduct collaborative research related to this proposal, i.e., with UBC (Booth, McGrenere), University of Saskatchewan (Gutwin), University of Toronto (Baecker, Balakrishnan), and Dalhousie (Inkpen). All are working on areas that complement the two themes described above.

3.2 Relationships between Industry and the Co-Chair applicants

Smart Technologies, Inc. The co-Chair applicants, both full-time tenured faculty members at the University of Calgary, have a longstanding and productive working relationship with Smart Technologies, Inc (SMART). SMART is very knowledgeable of the research activities and styles of the co-Chairs, while the co-Chairs understand the needs, expectations and culture of SMART. In particular, Greenberg has had grass-roots interaction with SMART for almost a decade, whereas Carpendale's interaction with SMART started when she joined the University of Calgary in 1999. Many of Carpendale and Greenberg's former students are now SMART employees. Greenberg has given both research lectures and tutorials at SMART, and in turn SMART staff has given lectures to both applicants' research groups. SMART also donated equipment to their laboratory several times, which was used as the basis for a variety of research projects. As a result of this interaction, both Greenberg and SMART were involved with the Alberta Science and Research Authority (ASRA) grant titled PACE: Prototyping Advanced Collaborative Environments. Recently, Carpendale's research into interfaces for tabletop displays interested SMART Technologies in the potential of tabletop displays and has led to collaborations in the design, construction and production of newer and better tabletop displays. This includes a partnership between Carpendale and SMART in the production of a very high-resolution multi-touch digital table; this not only created a new research platform for Carpendale, but introduced SMART into the opportunities of a new product genre.

Smart Technologies, Inc. then became one of two major sponsors of the 5.5 million dollar NSERC Research Network grant: "Network for Effective Collaboration Technologies through Advanced Research". Carpendale and Greenberg are members of this grant (Greenberg is a Theme Leader) and actively engage with SMART within this context.

SMART recently sponsored the iCORE / Smart Technologies Chairs in Interactive Technologies, with Greenberg and Carpendale as the Chair partners (as of September, 2006). SMART has committed to funding this Chair for 100,000 / year for five years, a total of $500,000. This is matched by iCORE, thus endowing the iCORE chair with a $1,000,000.

Finally, we anticipate much direct collaboration with SMART and their staff; this is reflected by their in-kind donation of $25,000 / year, much of which will go towards SMART salary to staff who will devote their time working with the Chairs. (We also anticipate that a portion of this in-kind commitment will arrive as equipment). As mentioned, the co-Chair applicants already have a long-standing collaboration with SMART that has led to many fruitful research endeavours, and a good number of their staff are former graduates of the Chairs' laboratory. SMART recently created a Research Manager position (Gerald Morrison). One of his primary duties is to interact regularly with the Chairs. Other individual SMART staff are already involved or are expected to be involved in Chair research projects of mutual interest.

Other Industries. The co-Chair applicants also have long-standing relationships with other industries. These have run in parallel with SMART's involvement in the past, so we see no obstacle to continuing these and/or new industrial involvements during the Chair period. Legally, the IP agreement that will become part of this Chair does not preclude these relationships. In particular,

- **Idelix Software Inc.** based out of Vancouver, B.C., is partially founded on the intellectual work of applicant Carpendale; Carpendale continues a research relationship with them.
- **Phidgets, Inc.** is a small Calgary-based company that arose directly out of Greenberg's research on physical user interfaces. Run by his former student Fitchett, Greenberg and the company continue to collaborate on development on physical devices that form the heart of Ubiquitous Computing installations. To avoid conflict of interest, they carefully separate research activities from commercial activities.
- **Microsoft and Microsoft Research (MSR)** have a long standing relationship with Greenberg. They have funded him for several years running in past years, and he has sent a variety of graduate students to top research groups at MSR as Research Interns during their graduate program. As mentioned above, Microsoft have also funded both Carpendale and Greenberg through their five year funding of the NSERC Research Networks Grant (Nectar).
- **Mitshubishi Electric Research Laboratories (MERL)** also has a relationship with both Carpendale and Greenberg. Students of both have worked at MERL as Research Interns, often leading to joint publications.

4. Research Management.

The Chairs will run the research program by consensus. This approach continues 5 years of successful collaborations between the Chair applicants running their Interactions Laboratory. The Chairs will modify the research program as needed, based on opportunities derived from the research, from information provided by the industrial sponsors, and from the desires and skills of HQP working on the various projects.

As mentioned, Smart Technologies, Inc. has hired a Research Manager who serves as the Chairs' main point of contact with the company. This Research Manager's role is to act as liaison: he will bring the Chairs' research to the attention of the company, will bring Company opportunities to the chair, and will help establish joint projects between the company and the Chair as good opportunities arise.

The Chairs also run a formal 'Demo Day' (usually once or twice a year), where they invite industry, academics, and other interested parties to a preview of their research results. These have been effective in the past for communicating research results to the broader community, and have often led to further discussions of new initiatives.

The Chairs have already hired an administrative assistant (as part of the iCORE contribution) to help with the day to day management of both the research laboratory and research administration, and to assist with research reporting. The Department of Computer Science has staff in place to handle broader financial issues related to grant management and to personnel (e.g., salaries). Our administrative assistant will work with that staff member so that the additional needs of the Chair can be handled effectively.

5. Training of Highly Qualified Personnel

Both co-chair applicants run a single laboratory – the *Interactions Laboratory* – dedicated to the training of highly qualified personnel in human computer interaction research. At any moment in time, the laboratory includes a broad variety of MSc and PhD students, undergraduate students (typically NSERC USRAs) and visiting student interns. The Chair will both support this existing rich HQP structure (as current grants now supporting our students end), while extending it significantly to include two new Post-doctoral researchers. Funding for Post-docs has always been a significant obstacle; their inclusion would not be possible if it were not for the Chair.

The inclusion of Smart Technologies Inc. as an industrial sponsor will give additional opportunities for advanced HQP training. This arises from SMART's willingness to develop state of the art equipment for us, from their real-world observations of how large display technologies are actually deployed in the field, from industrial opportunities that they see, and from opportunities to work with their research staff (some who are former graduates of our laboratory). SMART's CEO, David Martin, is particularly knowledgeable in both academic and industrial developments in these areas, and often contributes strategic insights into opportunities and issues related to large display technologies, their deployment, and their anticipated uptake in particular application domains.

As mentioned, both co-Chair applicants have working relationships not only with SMART but other companies as well. These have led to internship placement of select graduate students at state of the art industrial laboratories researching Interactive Technologies, e.g., Microsoft Research (Redmond, USA and Cambridge, UK), Mitshubishi Electronics Research Laboratories (Boston, USA) and Intel (Portland, USA). We believe these internships have significantly increased the training of our HQP students, and anticipate that this Chair will lead to further internship opportunities.

6. Value of Research Results and Benefits to Canada.

> " Canada is on the cusp of an advanced technology revolution. We have created a culture of innovation in this country - through our people, knowledge and opportunities..."
>
> *http://strategis.ic.gc.ca/epic/site/ict-tic.nsf/en/Home*

Effective interactive technology research will help Canadians realize the full potential of our investment in Information and Communications Technology (ICT) infrastructure. These technologies represent the next step in increasing efficiency and effectiveness in business, government and Canadian life. The development and adoption of these technologies is therefore important for Canada's global competitiveness. This belief is reflected Industry Canada's ICT website, as shown in the quote above. The same site also reports on the importance of ICT to Canada's financial health, with an estimate of 135.6 billion in ICT sector revenues for 2005.

While much of the successes of Canadian Technologies are based on hardware and infrastructure production, the role of interactive software and design of interactive technologies is becoming increasingly important. That is, the end use of the hardware is becoming the place to add value rather than the hardware itself. Indeed, many major Canadian industries now rely on innovations in interactive technology research to sell their products. Several well known larger Canadian companies include:

- ***Smart Technologies, Inc.*** (the industrial sponsor of this application), who is considered the world leader in interactive whiteboard technologies,
- ***Cognos, Inc.*** (an industrial sponsor of a different NSERC IRC grant), who are considered world leaders in business intelligence technologies,
- ***Research in Motion,*** the leading provider of wireless platforms for communication, e.g., the Blackberry,
- ***Alias Wavefront,*** the leading producer of animation software (acquired by Autodes, Inc. in 2006),
- ***Corel, Inc.*** who compete directly with Microsoft Inc. for productivity software
- ***Electronic Arts Canada***, one of the world leading producers of video games.

A variety of smaller companies also rely on novel interaction technologies to define their market niche. For example, the following three companies are direct outcomes of Greenberg or Carpendale's research:

- ***Phidgets, Inc.*** who creates hardware and software that allows researchers, developers and designers to rapidly prototyping novel physical user interfaces (www.phidgets.com),
- ***Idelix Software Inc.*** who specializes in the design and integration of advanced information visualization technologies (www.idelix.com)
- ***Teamwave Software Ltd.*** who developed novel groupware environments and web-based collaboration tools. This company was sold in late 2000 to the Boston-based Sonexis, where its technology was rolled into their products (http://www.markroseman.com/teamwave/).

All of these commercial accomplishments set the stage for major innovations in the way Canadians do business (both locally and globally), how they spend their leisure time (especially when using technology), and how they maintain the quality of life that has made Canada the envy of much of the world. Indeed, most of today's technical innovations will require advances in interactive technology before they can be fully realized.

We expect some of our results will be transferred into commercially available interaction technologies by companies in Alberta (e.g., SMART) and Canada. The Chair program will produce several tangible – as well as intangible – outputs: particular interaction technologies, tool prototypes, software frameworks and knowledge of social requirements of software.

Consider one example of the effect of interactive technology research to Canada. As addressed in this proposal, one of our goals is to increase the usability and functionality of very large electronic wall displays and tables. Most of today's display walls are passive, or use very simple notions of interaction (e.g., a single touch as a surrogate for a mouse selection). Our research will directly impact how interaction on such walls and tables is done. Again, this is reflected by Canadian companies who can

directly benefit from this research. Such displays are the main product of our industrial partner, SMART. Alias|Wavefront (now Autodesk) had also invested considerable research in considering how large displays can support design teams in areas such as automobile manufacturing.

The Chair results can be applied by ourselves or by receptors of our research to different vertical application areas. In many cases, expected benefits to Canadians go beyond product improvement, as it can directly affect quality of life issues. For example, interactive technologies are especially important in complex, hands-on fields such as medicine; the recent Romanow Report argues that ICT is a critical piece of the foundation for all of the reforms outlined in that report. One example of our research as applied to medicine includes studying shift change activities by nurses in a hospital ward [SC9], in particular how hand-offs are done. We expect large display technologies may help not only make this process more efficient, but it may also reduce medical errors due to faulty information exchange. Similarly, our information visualization techniques can help other research make sense of data about real Canadian problems, such as we have done with the Mountain Pine Beetle epidemic [SC7, SC34, SC44]. As well, information visualization as described in Theme 1 and the Tabletop and Wall display work in Theme 2 naturally combine to suggest new ways that Command and Control can be done within public institutions such as the military, the police, and emergency response teams [e.g., SG23], as well as for design brainstorming sessions and computer gaming [e.g., SG25].

7 References

Note: Citations prefixed with SC and SG are found in Carpendale's and Greenberg's P100 respectively.

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APPENDIX C
Referee Suggestions
(Form 101)

Complete Appendix C for all types of grants (except Discovery Grants, Research Tools and Instruments - Category 1 and Major Resources Support Grants). Read the instructions before completing the appendix.

Date: 2007/03/05

Family name of applicant	Given name	Initial(s) of all given names	Personal identification no. (PIN)
Salahub	Dennis	D.R.	10174

Title of proposal
NSERC/iCORE/Smart Technologies Industrial Research Chair in Interactive Technologies

A	Stasko (John) Graphics, Visualization & Usability Center College of Computing, Georgia Institute of Technolog 801 Atlantic Drive Atlanta, GA UNITED STATES 303320280 1 (404) 894 ext 5617 stasko@cc.gatech.edu	Area(s) of expertise Information Visualization, Groupware, Information Interfaces, Human Computer Interaction	**1**	PIN / Lang.
B	Lindgaard (Gitte) Psychology Carleton University 1125 Colonel By Drive Ottawa, ON K1S 5B6 1 (613) 520-2600 ext 2255 gitte_lindgaard@carleton.ca	Area(s) of expertise Human Factors, Human Computer Interaction, User centered product design	**2**	PIN / Lang.
C	Ware (Colin) Center for Coastal and Ocean Mapping University of New Hampshire 24 Colovos Road Durham, NH UNITED STATES 03824 1 (603) 862-1138 cware@ccom.unh.edu	Area(s) of expertise Information Visualization, Human Computer Interaction	**3**	PIN / Lang.
D	Muller (Hausi) Department of Computer Science University of Victoria ECS Building Rm 504 3800 Finnerty Road Victoria, BC CANADA V8P 5C2 1 (250) 472-5719 hausi@cs.uvic.ca	Area(s) of expertise Software Engineering	**4**	PIN / Lang.
E	Fels (Sid) Electrical and Computer Engineering The University of British Columbia 2356 Main Mall Vancouver, BC V6T 1Z4 1 (604) 822-5338	Area(s) of expertise Human Communication Technologies, Ubiquitous Comuting, Physical Interfaces	**5**	PIN / Lang.

NSERC reviewing committee	1st committee reviewer	Personal identification no. (PIN)
	2nd committee reviewer	Personal identification no. (PIN)
	3rd committee reviewer	Personal identification no. (PIN)

Support Letters

1. VP, Research & International, University of Calgary – Dr. Dennis Salahub
2. Smart Technologies, Inc. (Industrial Sponsor) – Dr. Gerald Morrison
3. VP Programs, iCORE Informatics Circle of Research Excellence (Government sponsor of iCORE chair) – Lynn Sutherland,
4. Dean, Faculty of Science, University of Calgary – Dr. Sandy Murphy
   (includes separate letter confirming teaching relief)
5. Head, Department of Computer Science, University of Calgary – Dr. Ken Barker

NOTE: Letters 1 and 4a are not included in this draft; they are being written now.

UNIVERSITY OF CALGARY

VICE-PRESIDENT (RESEARCH & INTERNATIONAL)

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March 6, 2007

Natural Sciences and Engineering Research Council of Canada
350 Albert Street
Ottawa, ON K1A 1H5

Attention: Ms. Pamela Moss

Dear Ms. Moss:

Re: Application for a joint NSERC/iCORE/SMART Technologies Industrial Research Chair in Interactive Technologies for Dr. Saul Greenberg and Dr. Sheelagh Carpendale

The University of Calgary strongly supports this application for an NSERC Industrial Research Chair in Interactive Technologies. The Chair is premised on the extraordinary potential of a research team that can transform how technology is integrated into society. This team will comprise an existing core of exceptional science researchers (Drs. Greenberg and Carpendale), and an expansion of this team by recruiting two new tenure-track faculty members (one in the chair area and another in the complementary area of software engineering/games). The Chair will greatly benefit from its partnership with Smart Technologies, Inc. (SMART), a dynamic Calgary-based mid-sized company doing innovative work in large display technologies.

The Chair represents a strong fit with the University of Calgary's strategic Research Plan, particularly but not exclusively in the broadly based areas of "Creating Technologies and Managing Information for the Knowledge Society", and "Understanding Human Behaviour, Institutions and Cultures". This University is committed to innovative graduate programming as well as to research directions that fully investigate innovative technology creation and how it can gracefully fit into human lives.

We anticipate that the proposed Chair will produce outcomes that will not only be internationally recognized but that will support the transfer of new ideas and directions between science and industry. The proposed themes of information visualization and embodied interaction draw on the high level skills of the core research team, and provides opportunities to attract high caliber new faculty (the anticipated two new hires) and graduates to the University. It also provides opportunities to work with researchers at other post-secondary institutions across the world as well as with industry partners. The Chair will assert leadership and innovation in Alberta's information technology sector.

In support of this exceptional promise, the University of Calgary is already building on its existing base of commitments to the core researchers (Drs Carpendale and Greenberg) beyond their salary, benefits and space allocations:

- recruitment of one (1) additional tenure track faculty member in the Department of Computer Science directly in the Chair research area, representing a yearly investment of approximately 100,000 for recruitment, reallocation, and ongoing salary and benefits per annum for the position
- recruitment of one (1) additional tenure track faculty member in the Department of Computer Science in Software Engineering (or optionally in the Games area, with skills complementary to the Chair research area, representing a yearly investment of approximately 100,000 for recruitment, reallocation, and ongoing salary and benefits per annum for the position
- appropriate space and resources typically associated with such appointments.

These strategic commitments are intended to assure the success of the Chair, and support its bid to take on international leadership in the development of innovative interaction technologies. The potential of the Chair to add value to Alberta's economy, particularly with its association with Smart Technologies, Inc., is also clear, and we respectfully submit to you this application as the key step in achieving the Chair vision.

Sincerely,

Dennis Salahub, Ph.D., FRSC, FAAAS
Vice-President (Research & International)

DS:dt
Enc.

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February 14th, 2007

c/o Saul Greenberg, Sheelagh Carpendale
Interactions Lab
Computer Science Dept.
The University of Calgary

To Whom it May Concern:

We at SMART Technologies Inc. (SMART) are pleased to participate in the establishment of the Industrial Chairs in Interactive Technologies Research at the University of Calgary.

For sometime we have been aware of the research conducted by Saul Greenberg and Sheelagh Carpendale in the Interactions Lab. We are also involved with the international research community in interactive technologies by way of several sponsorships, conference attendance and publications. Through our involvement with this community we have come to recognize that the research and people at the Interactions Lab are world class. In evidence of our recognition of the caliber of their research we have been and are now involved in several ways such as: joint work in research conference planning, potential collaboration of research publications, co-development of new technologies, and cross-fertilization of ideas in demonstrations and talks. We have also hired researchers both in the past and very recently who have graduated from this lab.

Our involvement with the interactive technologies community in general also includes funding. SMART is one of the major corporate sponsors to the NSERC Research Network grant, the Network for Effective Collaboration Technologies through Advanced Research (NECTAR) – both Dr. Greenberg and Dr. Carpendale are members of this grant. SMART has also contributed funds to other Canadian agencies working in this area: Communications and Information Technology Ontario (CITO), TRLabs, NEWT, and several conferences.

For the purpose of participating in the establishments of a co-Chair in Interactive Technologies at the University of Calgary, SMART has committed the sum of $100,000 (CDN) per year for a period of five years to Alberta's iCORE Industrial Chair program. This Chair has now been awarded, and Smart has just finalized the Intellectual Property Agreement with the University of Calgary. Our funding anticipated matching funds by iCORE (which is now in place). Our funding also anticipated a high probability that it would be matched in full or in part by the National Sciences and Engineering Research Council of Canada (NSERC) through their NSERC IRC program. This is important, as NSERC's match will result in a further iCORE match resulting in a strong endowment.

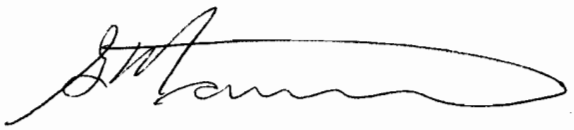
We believe that full matching funds by both iCORE and NSERC is critical. In total, these funds will provide sufficient stimulus so that substantial research and HQP development in Interactive Technologies can be accomplished within the Chair program.

Other than direct cash support, SMART is also prepared to include a meaningful level of in-kind support by way of consultations, presentations, collaboration and possible equipment

loans. These are not included in the budget simply because the exact amounts have not yet been determined. Yet our record clearly demonstrates that it will happen. We already have a strong and long-standing history of such in-kind support with both Dr. Carpendale and Dr. Greenberg, and we believe this will continue. In addition, SMART is breaking ground for its new building next to the University – this increased proximity will likely result in direct collaborations between SMART, the chair-holders, their students, and their research staff.

The formation of the Industrial Chairs in Interactive Technologies is of significant interest to us as it will increase the potential for innovation and will finesse existing interaction techniques. While SMART recognizes that the Chairs' program includes long-term research, we anticipate that we can serve as a Canadian industry receptor to the near-term Chairs' research products. As well, SMART looks forward to the highly-trained personnel that will come out of this program; as previously stated, we have already hired University of Calgary graduates taught and/or supervised by the Chairs.

Sincerely,



Dr. Gerald Morrison
External Research Manager
SMART Technologies Inc.

INFORMATICS iCORE CIRCLE OF RESEARCH EXCELLENCE

February 21, 2007

Natural Sciences and Engineering
Research Council of Canada
350 Albert Street
Ottawa, ON K1A 1H5

Re: Industrial Research Chair in Interactive Technologies for Dr Saul Greenberg and Dr Sheelagh Carpendale

NSERC:

iCORE funds world class Information and Communications Technology research that can have an impact in the province of Alberta. In September of 2006 iCORE awarded a joint Industry Chair in Interactive Technologies to Dr Saul Greenberg and Dr Sheelagh Carpendale in support of their work in the area of Human Computer Interfaces. The iCORE award provides $100,000 per year for a total of $500,000 over five years. This matches funding of an additional $100,000 per year for a total of $500,000 from their industry partner SMART Technologies Inc. We expect that the quality of the candidates, the close partnership with industry, and the high quality personnel that will be produced, meet with the criteria for NSERC to become a significant funding partner in this Industrial Chair.

iCORE has been aware for many years of the exciting work that is conducted in the Visual and Interactive Computing group at the University of Calgary, led by Drs Greenberg and Carpendale. As co-chairs the goal of their research is to design, develop and evaluate interactive technologies so that they support the everyday-world practices of how people view, represent, manage and interact with information and how they collaborate with it. Their strong connection with Smart Technologies, Alberta's largest information and communications technology company, provides an outlet in Canada for commercializing the research results.

At iCORE we are strongly supportive of the current proposal for an NSERC Industrial Research Chair in Interactive Technologies that is being put forth by Dr Greenberg and Dr Carpendale. Research in interactive technologies complements and strengthens the existing knowledge base in Alberta and aligns with other initiatives in this province.

Sincerely,

Lynn Sutherland
Vice President, Programs

3608 - 33 STREET NW, CALGARY, ALBERTA, CANADA T2L 2A6
TEL: (403) 210 5335 FAX: (403) 210 5337 INFO@ICORE.CA WWW.ICORE.CA

UNIVERSITY OF CALGARY

FACULTY OF SCIENCE

Office of the Dean
Earth Science 640
Telephone: (403) 220-3293
Fax: (403) 282-9154
Email: jsmurphr@ucalgary.ca

March 2, 2007

Ms. Wendy Ryan
Program Officer
NSERC
350 Albert Street
Ottawa, Ontario K1A 1H5

RE : Application for an NSERC IRC in Interactive Technologies (Carpendale/Greenberg)

Dear Ms Ryan:

As Dean of the Faculty of Science, I am pleased to provide my enthusiastic support for this application.

Research in Information and Communication Technologies has passed beyond the purely technical. The bottleneck is now centered on the ways in which humans interact with digital information through displays and devices. This requires a much more cross-disciplinary view of technology. Indeed, the approaches used by the proposed chairs bring methodologies developed in Psychology, Social Sciences, Anthropology, Design and Arts along with industrial influences to the study and development of effective interactive technologies.

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The University of Calgary has identified "*Creating Technologies and Managing Information for the Knowledge Society*" as one of its four core academic priorities. This recognizes not only the existing expertise of individuals such as the applicants, but also acts as a guide to the allocation of resources. Commensurate with this the Faculty of Science has identified the research areas associated with the applicants to receive significant support. This domain also fits within the Department of Computer Science research pillars of Visual and Interactive Computing.

As a consequence, the Faculty of Science is keenly interested in seeing this Chair established. It therefore will dedicate resources in its own right to help make the proposal and the Chair successful.

The Faculty has already placed considerable resources towards Interactive Technologies research. Specifically, the Faculty of Science along with the Department of Computer Science now have in place:

- three direct faculty positions in the area (the tenured co-applicants Greenberg and Carpendale, and recent hire Sharlin)

- an extensive and completely furnished unified laboratory space currently housing faculty, graduate students, workstations and specialized equipment in Interactive Technologies

- commitments associated with other awards by the co-applicants, e.g., a University Professorship for research excellence (Greenberg) and a CRC (Carpendale) (both come with teaching and service relief), space for CFI and NSERC equipment (Carpendale/Greenberg), and relief associated with the iCORE Industrial Chair (Greenberg/Carpendale).

Further to these existing commitments, the Faculty of Science will commit:

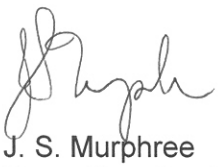
- recruitment of HCI faculty: the Faculty and the Computer Science Department will provide one tenure-track position in the area of Human Computer Interaction

- recruitment of Software Engineering faculty: the Faculty and the Computer Science Department will provide one tenure-track position in the area of Software Engineering, where the hiring committee will seek out a person with complementary skills in Interactive Technologies

- space: the faculty through the Department of Computer Science is able to support this initiative within its current space limits. The faculty is strongly committed to ensuring that this space remains available and is expanded to meet the growth of the group.

For the Faculty of Science, the interdisciplinary and industrial focus of this proposed chair heralds a new way of thinking about doing science research. We have already attracted many fine researchers in a large number of disciplines. What makes the proposed NSERC IRC Chair particularly appealing is that it will leverage both our existing strengths in Interactive Technologies and the proximity of Smart Technologies, Inc. It will transform an exceptionally strong group into a powerhouse.

Sincerely,



J. S. Murphree
Dean, Faculty of Science

UNIVERSITY OF CALGARY

MEMO

Faculty of Science

Office of the Dean
ES 640
Telephone: (403) 220-6286
Fax: (403) 282-9154
Email: jsmurphr@ucalgary.ca

To: To Whom It May Concern

Date: September 15, 2006

From: Dr. J.S. Murphree, Dean
Faculty of Science

Re: **iCORE Recipients Dr. Saul Greenberg Teaching Relief**

At the University of Calgary, Chairs are expected to carry at least 50% of the normal individual professorial teaching load for their home department. This will include teaching at both the graduate and undergraduate levels. They are also expected to supervise graduate students.

In the case of Dr. Greenberg, in order to provide 75% of protected time for research, the University will reduce the normal teaching load of three (3) half courses per year by 50%. Each recipient is committed to teaching two (2) half courses per year (normally one (1) per semester), one at the graduate and one senior undergraduate level, and to supervise graduate students.. It is expected that the recipient's teaching load will revert to normal upon completion of their terms as iCORE Chairholders.

S. Greenberg
Department of Computer Science
Faculty of Science

Sept 26/06
Date

J.S. Murphree
Dean, Faculty of Science

Sept 27, 2006
Date

D. Salahub
Vice-President (Research & International)

October 12, 2006
Date

A. Harrison
Vice-President (Academic) & Provost

October 20, 2006
Date

UNIVERSITY OF
CALGARY
DEPARTMENT OF COMPUTER SCIENCE

Dr. Ken Barker
Faculty of Science
2500 University Dr. NW
Calgary, Alberta, Canada
T2N 1N4

NSERC IRC Review Committee
NSERC
Ottawa,Ontario, Canada

February 23, 2007

Dear Committee Members,

The Department of Computer Science at the University of Calgary strongly supports Drs. Greenberg and Carpendale's application for an NSERC IRC to complement their current industrial iCORE / Smart Technologies Research Chairs in Interactive Technologies. These are two of our best researchers in the Department in a primary focus area for the Department, both of whom have established international reputations and the ability to continue to produce significant contributions into the foreseeable future. The proposed chairs will expand in a critical way our substantial reputation in the area of Visual and Interactive Computing, which has been a primary focus area for the Department and will continue to be critical to our long term success. The partnership with Smart Technologies, a Calgary-based industrial sponsor, also indicates the wide-reaching effects of this initiative and the implications for diversifying the Alberta economy are substantial. This proposal creates an archetype for how cutting-edge research can be undertaken with "home grown" Alberta-based industrial partnership to create the next generation of innovators.

The Visual and Interactive Computing is a key focus area for the Department and is a part of the Departments, Faculties, and University's strategic plan so I am confident in saying that it will be supported at all levels, at least in kind, but also with "hard dollar" support. Several distinct initiatives support this application and complement it without introducing any conflict. These include the proposed Alberta Ingenuity Centre for Interactive Technologies (AICIT), Dr. Carpendale's existing Canada Research Chair, Dr. Greenberg's recently awarded University Professorship in addition to the role of both of them on their current NSERC Nectar Research Networks grant. Both applicants are given the necessary release time from non-research duties to ensure this proposal is successful and their strong academic collaborations promise a continuation of their long and productive working relationship. The formal addition of Smart Technologies to this collaboration is very promising indeed.

The Department of Computer Science's support for this initiative goes beyond the intangible however. The Department is committed to support both researchers by:

- ***Teaching and Service Relief.*** Drs. Greenberg and Carpendale have been very successful at attracting external recognition and support so the University is able to support the Department's teaching requirements by halving what is normally expected. With the addition to a reduction in administrative service responsibilities, both will be able to focus primarily on their research agendas.

2500 University Drive N.W., Calgary, Alberta, Canada T2N 1N4
Telephone: (403) 220-8497 Fax: (403) 284-4707 email address: barker@cpsc.ucalgary.ca

- ***Recruitment.*** The Computer Science Department will fill the currently open Software Engineering position with a person having interests in an area to support this application. In addition, the funds from a successful NSERC IRC application will be used to fund a new position in HCI directly related to the Chair proposal. We are also actively recruiting a person in the area of Computer Games and believe this individual will likely participate in research closely related to this proposal as well.
- ***Space.*** The Department is currently able to support this initiative within its current limits and is strongly committed to ensuring that this space remains available and is expanded to meet the growth of the group.
- ***Equipment.*** The Department has traditionally assisted through infrastructure needs and by partially matching grant contributions to ensure that the equipment available to the group is state-of-the-art. The Department is committed, subject to budgetary constraints, to enhance this in support of this proposal and to expand it to ensure that $10,000 per year is available to maintain the equipment over the lifetime of the application.

In summary, much of the commitment to support this initiative is already in place so it is easy for the Department to make this commitment formal. We are very excited by this proposal; it fits in with our current and future plans, expands on excellence within the Department, provides opportunities for future provincial diversification, and opens innumerable exciting new research opportunities. I wish we could do more to ensure its success as it matches the underlying forward-looking philosophy of the Department. If problems arise, we will work with the applicants to ensure that their proposal has every chance of success.

I look forward to a successful result from your review process and if I can do anything further to help, please do not hesitate to contact me directly.

Sincerely,

Ken Barker
Professor and Head

NSERC CRSNG *Investing in people, discovery and innovation*
Investir dans les gens, la découverte et l'innovation

FORM 100
Personal Data Form
PART I

Date: 2007/03/05

Family name	Given name	Initial(s) of all given names	Personal identification no. (PIN)
Carpendale	Sheelagh	MST	146129

☐ I hold a faculty position at an eligible Canadian college (complete Appendices B1 and C)

☐ I do not or will not hold an academic appointment at a Canadian postsecondary institution

Place of employment other than a Canadian postsecondary Institution (give address in Appendix A)

APPOINTMENT AT A POSTSECONDARY INSTITUTION

Title of position: Associate Professor

Department: Computer Science

Campus:

Canadian postsecondary institution: Calgary

Tenured or tenure-track academic appointment — Yes [X] No [ ]

Part-time appointment [ ] Full-time appointment [X]

- For all non-tenured or non tenure-track academic appointment and Emeritus Professors, complete Appendices B & C
- For life-time Emeritus Professor and part-time positions, complete Appendix C

ACADEMIC BACKGROUND

Degree	Name of discipline	Institution	Country	Date yyyy/mm
Bachelor's	Computer Science	Simon Fraser University	Canada	1992 / 06
Doctorate	Computer Science	Simon Fraser University	Canada	1999 / 03

TRAINING OF HIGHLY QUALIFIED PERSONNEL

Indicate the number of students, fellows and other research personnel that you:

	Currently		Over the past six years (excluding the current year)		
	Supervised	Co-supervised	Supervised	Co-supervised	Total
Undergraduate			8		8
Master's	3	2	5		10
Doctoral	4		1	1	6
Postdoctoral	1				1
Others	1		12		13
Total	9	2	26	1	38

Personal information collected on this form and appendices will be stored in the Personal Information Bank for the appropriate program.
PROTECTED WHEN COMPLETED

Version française disponible

Completed

Personal identification no. (PIN)	Family name
146129	Carpendale

ACADEMIC, RESEARCH AND INDUSTRIAL EXPERIENCE (use one additional page if necessary)

Position held (begin with current)	Organization	Department	Period (yyyy/mm to yyyy/mm)
Associate Professor	Calgary	Computer Science	2004/07
Adjunct Senior Artist / Researcher	Banff Centre for the Arts	Banff New Media Institute	2001/06 to 2007/04
Computer Visualization Consultant	Braunarts	Antarctic Waves Project	2001/05 to 2002/12
Assistant Professor	University of Calgary	Computer Science	2000/07 to 2004/06
Limited Term Faculty	University of Calgary	Computer Science	1999/10 to 2000/06
Research Associate	Simon Fraser University	SEED project School of Computing Science	1996/09 to 1999/09
Teaching Assistant	Simon Fraser University	School of Computing Science	1996/01 to 1996/04
Part time Research Assistant	Simon Fraser University	School of Computing Science	1992/09 to 1996/08
Full time Research Assistant	Simon Fraser University	School of Computing Science	1992/01 to 1992/08

Personal identification no. (PIN)	Family name
146129	Carpendale

ACADEMIC, RESEARCH AND INDUSTRIAL EXPERIENCE (use one additional page if necessary)

Position held (begin with current)	Organization	Department	Period (yyyy/mm to yyyy/mm)
Computer Consultant	Interactive Video Disc Project	KYAC(Knowledge for Youths About Careers)	1991/05 to 1991/12
Software Designer	MPR Teltech Ltd.		1990/09 to 1990/12
Programmer	ALI Technologies		1989/09 to 1989/12

PROTECTED WHEN COMPLETED

Personal identification no. (PIN)	Family name
146129	Carpendale

RESEARCH SUPPORT

Family name and initial(s) of applicant	Title of proposal, funding source and program, and time commitment (hours/month)	Amount per year	Years of tenure (yyyy)
List all sources of support **(including NSERC grants and university start-up funds)** held as an applicant or a co-applicant: a) support held in the past four (4) years but now completed; b) support currently held, and c) support applied for. For group grants, indicate the percentage of the funding directly applicable to your research. Use additional pages as required.			
a) Support held in the past 4 years			
Carpendale, M.S.T.	Information Visualization Methodologies NSERC 100 hours/month	20,000 20,000 20,000	2000 2001 2002
Carpendale M.S.T.	Investigating Elastic Presentation Libraries Intel Corp. 20 hours/month	96,135 69,178 71,536	2000 2001 2002
Carpendale M.S. T.	NSERC University Faculty Award (UFA) 20 hours/month	40,000 40,000 40,000 40,000 40,000	2000 2001 2002 2003 2004
Carpendale, M.S.T.	Equipment Grant Intel	18,000 6,200	2001 2002

PROTECTED WHEN COMPLETED

Canada

Personal identification no. (PIN)	Family name
146129	Carpendale

RESEARCH SUPPORT

List all sources of support **(including NSERC grants and university start-up funds)** held as an applicant or a co-applicant: a) support held in the past four (4) years but now completed; b) support currently held, and c) support applied for. For group grants, indicate the percentage of the funding directly applicable to your research. Use additional pages as required.

Family name and initial(s) of applicant	Title of proposal, funding source and program, and time commitment (hours/month)	Amount per year	Years of tenure (yyyy)
a) Support held in the past 4 years			
Carpendale, M.S.T.	Collaborative Visualisation Lab CFI New Opportunities, equipment grant 10 hours/month	293,000	2001
Brian Wyvill PI plus 28 others	3D Web Research Network Canadian Heritage New Media Research Networks Fund 10 hours/month	700,000 (5%) 700,000 (5%)	2003 2004
Carpendale M. S. T.	Mountian Pine Beetle Decision Support Key Canadian Forest Services 10 hours/month	20,000	2005
b) Support currently held			
Ron Baeker PI plus 10 others, Carpendale, M.S.T.	The Network for Effective Collaboration Technologies NSERC NSERC Research Network Grants (RNG) 30 hours/month	1,100,000 (6%) 1,100,000 (6%) 1,100,000 (6%) 1,100,000 (6%) 1,100,000 (6%)	2003 2004 2005 2006 2007

Personal identification no. (PIN)	Family name
146129	Carpendale

RESEARCH SUPPORT

Family name and initial(s) of applicant	Title of proposal, funding source and program, and time commitment (hours/month)	Amount per year	Years of tenure (yyyy)
List all sources of support **(including NSERC grants and university start-up funds)** held as an applicant or a co-applicant: a) support held in the past four (4) years but now completed; b) support currently held, and c) support applied for. For group grants, indicate the percentage of the funding directly applicable to your research. Use additional pages as required.			
b) Support currently held			
Carpendale M. S. T.	Information Visualization Methodologies NSERC Discovery Grant 40 hours/month	34,000 34,000 34,000 34,000	2003 2004 2005 2006
Carpendale M. S. T.	Information Visualization Lab CFI CRC Chairs: equipment grant	182,000	2004
Carpendale M. S. T.	InformationVisualization NSERC Canada Research Chair 20 hours/month	100,000 (40%) 100,000 (40%) 100,000 (40%) 100,000 (40%) 100,000 (40%)	2004 2005 2006 2007 2008
Carpendale M. S. T. and 3 others	Computing and the Arts University of Calgary Inquiry & Blended Learning, Course Development & Enhancement	5,000 5,000	2006 2007

Personal identification no. (PIN)	Family name
146129	Carpendale

RESEARCH SUPPORT

Family name and initial(s) of applicant	Title of proposal, funding source and program, and time commitment (hours/month)	Amount per year	Years of tenure (yyyy)
List all sources of support **(including NSERC grants and university start-up funds)** held as an applicant or a co-applicant: a) support held in the past four (4) years but now completed; b) support currently held, and c) support applied for. For group grants, indicate the percentage of the funding directly applicable to your research. Use additional pages as required.			
b) Support currently held			
Carpendale, M.S.T. and Greenberg, S.	Interactive Technologies SMART Technologies and iCORE Industrial Chair 20 hours/month	200,000 (50%) 200,000 (50%) 200,000 (50%) 200,000 (50%) 200,000 (50%)	2006 2007 2008 2009 2010

PROTECTED WHEN COMPLETED

Canada

Highly Qualified Personnel (HQP)

Provide personal data about the HQP that you currently, or over the past six years, have supervised or co-supervised.

Personal identification no. (PIN)	Family name
146129	Carpendale

Name	Type of HQP Training and Status	Years Supervised or Co-supervised	Title of Project or Thesis	Present Position
Eric Penner	Master's (In Progress)	Supervised 2006 -	Methods for exploring internal regions of 3D visualizations	Master's student, University of Calgary
Martin Schwartz	exch. student (In Progress)	Supervised 2006 -	Digital Finger Painting	Diplom student, University of Magdeburg
Matthew Tobiasz	Master's (In Progress)	Supervised 2006 -	Information visualization: specific topic to be determined	Master's student, University of Calgary
Uta Hinrichs	Master's (In Progress)	Supervised 2006 -	Fluid interactions on tabletop displays	Master's student, University of Calgary
Charlotte Tang	Doctoral (In Progress)	Supervised 2004 -	Asynchronous Co-located Collaboration	PhD student, University of Calgary
Mark Hancock	Doctoral (In Progress)	Supervised 2004 -	Physically Based Interactions on Tabletop Displays	PhD student, University of Calgary
Petra Neumann	Doctoral (In Progress)	Supervised 2004 -	Collaborative Information Visualization on Large Displays	PhD student, University of Calgary
Tobias Isenberg	Postdoctoral (In Progress)	Supervised 2004 -	Non-Photorealistic Techniques in Information Visualization	Post Doctoral fellow, University of Calgary
Annie Tat	Master's (In Progress)	Co-supervised 2003 -	Visualizing Human Dialog	Masters student, Computer Science & Fine Arts
Jeroen Keijser	Master's (In Progress)	Co-supervised 2003 -	3D Interaction	Masters student, University of Calgary
Torre Zuk	Doctoral (In Progress)	Supervised 2003 -	Visualizing Uncertainty	PhD student, University of Calgary
Andrew Seniuk	Undergraduate (Completed)	Supervised 2006 - 2006	USRI: visualizing programming language structure	Undergraduate, University of Calgary
André Miede	exchan. student (Completed)	Co-supervised 2005 - 2006	Interaction framebuffer for high resolution displays	Senior Management Analyst: BearingPoint, Germany
Lothar Schlesier	exchan. student (Completed)	Co-supervised 2005 - 2006	Interactive Visualization of Mountain Pine Beetle Data	graduated in Sept. considering job options
Simon Nix	Undergraduate (Completed)	Supervised 2005 - 2006	Interactive lenses for tabletop displays	Programmer, Electronic Arts (internship)
Elena Fanea	Master's (Completed)	Supervised 2001 - 2006	Visualizations of Multi-Dimensional Data	Research Programmer: Sun Cr Excellence for Visual Genomics
Katherine Mason	Doctoral (Completed)	Supervised 2000 - 2006	A Framework for Element-Based Computer Graphics	Software Engineer II: Electronic Arts
Ryan Schmidt	Research Assist (Completed)	Supervised 2004 - 2005	Construction of and Interaction for Wall Displays	PhD student, University of Toronto
Uta Hinrichs	exch. student (Completed)	Co-supervised 2004 - 2005	Interface Currents for Tabletop Displays	Masters student, University of Calgary
(Name withheld)	Master's (Not Completed)	Supervised 2002 - 2005	Multi-Resolution Lenses	Yoga Instructor, Taiwan

Highly Qualified Personnel (HQP)

Provide personal data about the HQP that you currently, or over the past six years, have supervised or co-supervised.

Personal identification no. (PIN)	Family name
146129	Carpendale

Name	Type of HQP Training and Status	Years Supervised or Co-supervised	Title of Project or Thesis	Present Position
Stacey Scott	Doctoral (Completed)	Co-supervised 2002 - 2005	Collaborating on Tabletop Displays	Post Doctoral Fellow, MIT
Nelson Wong	Master's (Completed)	Supervised 2001 - 2005	Edge Lenses	PhD student, University of Saskatewan
Eric Penner	Undergraduate (Completed)	Supervised 2004 - 2004	Interactivity on Large Displays	Programmer, Radical Entertainment
Matthew Tobiasz	Undergraduate (Completed)	Supervised 2004 - 2004	Lenses for geographic flow data	Master's, my supervision, University of Calgary
(Name withheld)	exch. student (Completed)	Co-supervised 2004 - 2004	Developing storage bins in tabletop interfaces	programmer, Europe
Anand Agrawala	Undergraduate (Completed)	Supervised 2003 - 2004	Super Skewer - 3D Graph Interaction for Large Displays	MSc. U. of Toronto, now CEO & President of Bump Technologies
(Name withheld)	exch. student (Completed)	Co-supervised 2003 - 2004	Interface for digital batik	programmer, Europe
(Name withheld)	PhD ex student (Completed)	Co-supervised 2003 - 2004	Intergrating lenses in 3D models	completing PhD in Germany
(Name withheld)	exch. student (Completed)	Co-supervised 2003 - 2004	3D lenses for 3D models	programmer, Europe
Russell Kruger	Master's (Completed)	Supervised 2002 - 2004	Orientation on Tabletop Displays	Intellectual Property Law student, University of Calgary
Erin Wallace	Undergraduate (Completed)	Supervised 2003 - 2003	Interacting with Information on Tabletop Displays	Human-Computer Interaction Software Developer
(Name withheld)	exch. student (Completed)	Co-supervised 2002 - 2003	Interactive probe for 3D data	software company in Europe
(Name withheld)	Master's (Completed)	Supervised 2001 - 2003	Simulating and Visualizing Genetic Regulation	Bioinformatics/IT Manager, S. Ab. Mass Spectrometry Centre
Petra Neumann	exch. student (Completed)	Co-supervised 2002 - 2002	A Taxonomy of Discrete Lenses	PhD student, my supervision, University of Calgary
Russell Kruger	Undergraduate (Completed)	Supervised 2001 - 2002	Interface characteristics of tabletop displays	Intellectual Property Law student, Univeristy of Calgary
Shannon Goodman	Research Assist (Completed)	Supervised 2001 - 2001	Studying Usability of Different Zoom Techniques	Human-Computer Interaction Software Developer
Catherine Montagnese	Res. Associate (Completed)	Supervised 2000 - 2001	EPS Software Library of Distortion Techniques	Software Researcher - Idelix, interaction design
(Name withheld)	Undergraduate (Completed)	Supervised 2000 - 2001	Bubble lenses for graph exploration	software developer

1. Five Most Significant Research Contributions

Rotation and Translation on Tabletop Displays: Orientation is a significant interface issue at least in part because individuals sitting around the display have different views of the workspace. Our investigation into the role of orientation in tabletop collaboration revealed that orientation plays three major roles: comprehension, coordination, and communication. To better support the roles of orientation, we designed, developed and evaluated a fluid interface mechanism, Rotate 'N Translate (RNT) that provides integrated control of rotation and translation and is usable with common input technology. Significance of this research is indicated by:

- Publication: ACM Group'03 [35], J-CSCW [2] ACM SIGCHI'05 [29].
- Further Research: Master's thesis at another university is based on the original observational study; R'NT is being incorporated into other tabletop research: industry collaboration [21], 3 graduate theses thus far and its application to software engineering agile programming is generating industry interest.

Territoriality on Tabletop Displays: Based on our observational studies, we recognized that tabletop territoriality helps coordinate task and group interactions during collaboration. This theory has led to the development of an entirely new tabletop display interaction environment that supports the organization and sharing of digital information during collaboration.

- Publication: CSCW'04 [31], CG&A [1], SIGGRAPH [45], and others such as [14, 18, 25, 43].
- Further Research: in part based on this research, I was asked to join a Canadian NSERC Research Network, NECTAR. My PhD student, S.D. Scott, now Post Doctoral Fellow at MIT, will be starting a tenure track position at University of Waterloo in July 2007.
- Industry Interest: The best indication of the impact of this research is that a private demonstration to researchers and the CEO of SMART Technologies (a successful Calgary-based large display company) has prompted them to see tabletop displays as interesting and we have started joint work on the design of new tabletop displays. This has contributed to my SMART/iCORE Chair.

Elastic Presentation Framework (EPF) is a significant contribution to Information Visualization that unifies many previously developed presentation methods, allowing the seamless inclusion of more than one presentation method in a single interface. By interpolating between the methods it describes, EPF identifies new presentation variations. EPF has received considerable academic and industrial attention.

- Academic: EPF has been well disseminated [4, 32, 36, 39, 41] including top venues such as CHI letters designated ACM UIST. Many academic and industrial invited presentations including Stanford, Intel, Electronic Arts, Dagstuhl, IIID-(UNESCO sponsored).
- Industrial: Intel provided a major research grant (~$225K plus equipment) to take the geometric framework, EPF, and develop a software library leading to collaboration with several international researchers – Gutwin, Saskatoon; Strothotte, Magdeburg Germany, Nighten, V2, Rotterdam, The Netherlands; Cohen, Oregon Graduate Institute; Inkpen, Dalhousie.
- Also Vancouver based Idelix Software Inc., focuses on software based on EPF - (see tech. transfer).

Occlusion Reduction Techniques: The concepts developed in EPF have proven to be extensible to occlusion-reduction techniques that can be applied to 2D and 3D representations. This stream of research has been published in top venues (CHI, IEEE InfoVis, CG&A) and is a chapter in Card et al.'s Readings in Information Visualization, which is considered the foremost book on Information Visualization. Recent work in this direction has included developing techniques that can be used as an explosion probe for 3D data exploration [24, 33] and an occlusion reduction technique for interactively dealing with edge congestion in graphs [11, 36]. This research is included in graduate level Information Visualization syllabi and frequently prompts image and video requests.

Visualizing Bio-Dynamics: Our research into visualizing genetic regulatory processes (collaborators: C. Baker: Southern Alberta Mass Spectrometry Centre, M. Surette: CRC Microbial Gene Expression, P. Prusinkiewicz, Computer Science) has been well received (Journal of Information Visualization [3],

IEEE Visualization [37]). Visualizing genetic dynamics extended the visualization ideas that were initially developed on a landscape scale (SEED: Simulating and Exploring Eco-system Dynamics). The SEED results were largely disseminated directly through outreach to government agencies and companies, such as the BC Min. of Forests, Canadian Forest Services, model forest network, companies such as MacMillan Bloedel, and environmental non-governmental organizations such as the Vancouver Island Marmot Recovery Team. Through an extension of this collaboration (T. Shore, B. Reid, J. Hughes Canadian Forest Services; A. Fall Gowlland Technologies; M Eng, BC Ministry of Forests) we have been developing visual decision support tools to help landscape managers cope with mountain pine beetle data catastrophe [12, 40, 49].

2. Other Research Contributions: Selected Publications (Student authors are marked in **bold** font)
Refereed Journals

1. **Scott**, S.D., Carpendale, M.S.T., **Habelski**, S. (2005) Storage Bins: Mobile Storage for Collaborative Tabletop Displays. *IEEE Journal of Computer Graphics & Applications, Special Issue on Large Displays*, 25(4), p 58-65.
2. **Kruger**, R., Carpendale, M.S.T., **Scott**, S.D., Greenberg, S. (2004) Orientation and Collaboration on Tables: Comprehension, Coordination and Communication. *Journal of Computer Supported Cooperative Work Springer, 13(5-6)*, p 501-537.
3. **Baker**, C.A.H., Carpendale, M.S.T., Surette, M., Prusinkiewicz, P. (2003) GeneVis: Simulation and Visualization of Genetic Networks. *Journal of Information Visualization*, *Special Issue on Coordinated Multiple Views, ed. J. Roberts, Palgrave-Macmillan, 2(4)*, p 201-217.
4. Carpendale, M.S.T. (2001) Elastic Presentation Space. *Information Design Journal, 10(1)*, *John Benjamin's Publishing Co.,* p 58-69.
5. **van der Heyden**, J., Inkpen, K., Atkins, S., Carpendale, M.S.T. (2001) Exploring Presentation Methods for Tomographic Medical Image Viewing. *Journal of Artificial Intelligence in Medicine, Special Issue, Information Visualization in Medicine*, *vol. 22*, p 89-109.

Full Papers in Fully Refereed Conferences/Symposium Proceedings
IEEE Vis, InfoVis are 1st –tier visualization conferences. ACM CHI, CSCW and UIST are 1st –tier HCI conferences. Most conferences acceptance rates ~20%.

6. Neumann, P., Tat, A., Zuk, T., Carpendale, S. KeyStrokes: Personalizing Typed Text with Visualization. In press: *Eurographics/IEEE VGTC Symposium on Visualization* 2007.
7. Collins, C., Carpendale, S., Penn, G. Visualization of Uncertainty in Lattices to Support Decision-Making. In press: *Eurographics/IEEE VGTC Symposium on Visualization* 2007.
8. Hancock, M.S., Carpendale, S., Cockburn, A. Shallow-Depth 3D Interaction: Design and Evaluation of One-, Two- and Three-Touch Techniques. In press: *Conf. Human-Computer-Interaction, CHI'06*.
9. Tang, C., Carpendale, S. An Observational Study on Information Flow during Nurses' Shift Work. In press: *Conf. on Human-Computer-Interaction, CHI'06*.
10. Keijser J., Carpendale, S., Hancock, M.S., Isenberg, T. (2007). Exploring 3D Interaction in Alternate Control-Display Space Mappings. In press: *Proc. IEEE Symposium on 3D User Interfaces, 3DUI'07*
11. **Wong**, N., Carpendale, S. (2007) (in press) Supporting Interactive Graph Exploration Using Edge Plucking. *Proc. Conference on Visualization and Data Analysis, SPIE-IS&T Electronic Imaging.*
12. **Schlesier**, L., **Hughes**, J., Fall, A., Carpendale, S. (2006) The LuMPB Key: A Multiple View Interface to Explore High Dimensional Mountain Pine Beetle Simulation Data. *Proc. International Conference on Coordinated and Multiple Views, CMV'06*, IEEE Computer Society Press.
13. Isenberg, T., **Neumann**, P., Carpendale, S., Costa-Sousa, M., Jorge, J. (2006) Non-Photorealistic Rendering in Context: An Observational Study. *Proc. Symposium on Non-Photorealistic Animation and Rendering, NPAR'06*, ACM Press, p 115-126.

14. **Hinrichs**, U., Carpendale, S., **Scott**, S.D. (2006) Evaluating the Effects of Fluid Interface Components on Tabletop Collaborations. *Advanced Visual Interfaces, AVI'06*, ACM Press, p 27–34.
15. **Hancock**, M.S., Miller, J.D., Greenberg, S., Carpendale, S. (2006) Exploring Visual Feedback of Change Conflict in a Distributed 3D Environment. *Advanced Visual Interfaces,* ACM, p 209–218
16. **Neumann**, P., Carpendale, S., **Agarawala**, A. PhylloTrees: Phyllotactic Patterns for Tree Layout. *Proc. Eurographics/IEEE VGTC Symposium on Visualization, EuroVis'06*, p 59–66, 2006.
17. **Tang**, A., Tory, M., Po, B., **Neumann**, P., Carpendale, S. (2006) Gestures and Visualizations: Collaborative Coupling over Tabletop Displays. *Conf. on Human-Computer-Interaction, CHI'06*, ACM Press, p 1181-1290
18. Isenberg, T., **Miede**, A., Carpendale, S. (2006) A Buffer Framework for Supporting Responsive Interaction in Information Visualization Interfaces. *Proc. International Conference on Creating, Connecting and Collaborating through Computing, C5'06*, IEEE Computer Society, p 262-269.
19. **Zuk**, T., Carpendale, S. (2006) Theoretical Analysis of Uncertainty Visualizations. *Proc. Conference on Visualization and Data Analysis, SPIE-IS&T Electronic Imaging, Vol. 6060, 606007*.
20. **Tat**, A., Carpendale, S. (2006) CrystalChat: Visualizing Personal Chat History. *Persistent Conversations, Hawaii International Conference on System Sciences, HICSS-39*.
21. **Hancock**, M.S., Vernier, F.D., **Wigdor**, D., Carpendale, S., Shen C. (2006) Rotation and Translation Mechanisms for Tabletop Interaction. *IEEE International Workshop on Horizontal Interactive Human-Computer Systems, TableTop06,* p 79–86.
22. **Zuk**, T., Carpendale, S., Glanzman, W.D. Visualizing Temporal Uncertainty in 3D Virtual Reconstructions. *Proc. International Symposium on Virtual Reality, Archaeology and Cultural Heritage, VAST'05, cooperation with ACM and Eurographics*, p 99-106, 2005
23. **Fanea**, E., Carpendale, S., Isenberg, T. (2005) An Interactive 3D Integration of Parallel Coordinates and Star Glyphs. *Proc. IEEE Symposium on Information Visualization, InfoVis'05*, p 149-156.
24. **Sonnet**, H., Carpendale, S., Strothotte, T. (2005) Integration of 3D Data and Text: The Effects of Text Positioning, Connectivity, and Visual Hints on Comprehension. *Proc. INTERACT 2005, International Conference on Human-Computer Interaction*, p 615-628.
25. **Hinrichs**, U., Carpendale, S., Scott, S.D., **Pattison**, E. (2005) Interface Currents: Supporting Fluent Collaboration on Tabletop Displays. *Proc. Smart Graphics. Lecture Notes in Computer Science. Springer, vol. 3638*, p 185-197.
26. **Mason**, K., Denzinger, J., Carpendale, S. (2005) Negotiating Gestalt: Artistic Expression by Coalition Formation between Agents. *Smart Graphics. Lecture Notes in Computer Science.* Springer*, vol. 3638*, p 103-114.
27. **Neumann**, P., Schlechtweg, S., Carpendale, S. (2005) ArcTrees: Visualizing Relations in Hierarchical Data. *Proc. of Eurographics/IEEE VGTC Sym. on Visualization, EuroVis'05*, p 53-60.
28. Isenberg, T., Carpendale, S., Costa-Sousa, M. (2005) Breaking the Pixel Barrier. *Proc. Eurographics Workshop on Computational Aesthetics in Graphics, Visualization and Imaging*.
29. **Kruger**, K., Carpendale, S., **Scott**, S.D., **Tang**, A. (2005) Fluid Integration of Rotation and Translation. *Proc. ACM Conference on Human-Computer-Interaction, CHI'05*, p 601-610
30. **Zuk**, T., Carpendale, S. (2005) Interactive Simulation and Visualization using the GPU. *Proc. Conference on Visualization and Data Analysis, SPIE-IS&T Electronic Imaging*, p 262-273
31. **Scott**, S.D., Carpendale, S., Inkpen, K.M. (2004). Territoriality in Collaborative Tabletop Workspaces. *Proc. ACM Conference on Computer-Supported Cooperative Work, CSCW'04, CHI Letters vol. 6(3)*, ACM Press. p. 294-303.
32. Carpendale, S., Light, J., **Pattison**, E. (2004) Achieving Higher Magnification in Context. *Symposium on User Interface Software and Technology, CHI Letters 6(2)*, ACM Press, p 71-80.

33. **Sonnet**, H., Carpendale, S., Strothotte, T. (2004) Integrating Expanding Annotations with a 3D Explosion Probe. *ACM Advanced Visual Interfaces*, ACM Press. p. 61-70.
34. Wyvill, B., van Overveld, K., Carpendale, S. (2004) Creating Cracks for Batik Renderings. *Proc. Non-Photorealistic Animation and Rendering, NPAR'04*, ACM Press. p. 61-67.
35. **Kruger**, K., Carpendale, S., **Scott**, S.D., Greenberg, S. (2003) How People Use Orientation on Tables: Comprehension, Coordination and Communication. *Proc. of the ACM Group 2003 International Conference on Supporting Group Work,* ACM Press. p. 369-378.
36. **Wong**, N., Carpendale, S. Greenberg, S. EdgeLens: An Interactive Method for Managing Edge Congestion in Graphs. *IEEE Symposium on Information Visualization, InfoVis'03*. p 51-58, 2003
37. **Baker**, C.A.H, Carpendale, S., Surette, M., Prusinkiewicz, P. GeneVis: (2002)Visualization Tools for Genetic Regulatory Network Dynamics. *IEEE Conference on Visualization*, p. 243-250.
38. **Tat**, A., Carpendale, S. (2002) Visualizing Human Dialog. *Proc. Conference on Information Visualization IV'02*, p. 16-24, London, **(a Best Paper Award)**
39. Carpendale, S., Montagnese, C. (2001) A Framework for Unifying Presentation Space. *Symposium on User Interface Software and Technology, UIST'01, CHI Letters 3(2)*, p 61-71, ACM Press.
40. – 42. full papers in IEEE IV'02, NordiCHI'02 and Graphics Interface'01

Book Chapters

43. Scott, S.D., Carpendale, S. (2006). Guest Editor's Introduction: Interacting with Digital Tables. *IEEE Computer Graphics & Applications Special Issue Interacting with Digital Tabletops, 26(5),* p 24-27.
44. Carpendale, S. (2003) Viewing Transformations: Perspective, Distortion and Deformation. In *SIGGRAPH'03 Course Notes; Theory and Practice of Non-Photorealistic Graphics: Algorithms, Methods, and Production Systems Presentation. Ed. Mario Costa-Sousa. ACM SIGGRAPH*'03

Short Papers in Fully Refereed Conferences/Symposium Proceedings

45. **Hinrichs**, U., Carpendale, S., **Scott**, S.D. (2005) Interface Currents: Supporting Fluent Face-to-Face Collaboration. *Technical Sketch, Proceedings of SIGGRAPH '05*, ACM Press.
46. Carpendale, S., **Xing**, R. (2001) Examining Edge Congestion. *Conference on Human Factors in Computing Systems, ACM CHI'01, Conference Companion*, p 115-116, ACM Press.
47. **Mason**, K., Carpendale, S. (2001) Artist-Driven Expressive Graphics. *Proc. of Eurographics: Short Papers*, p 87-96.

Refereed Workshop Contributions

48. Isenberg, T., Carpendale, S., Costa Sousa, M. Breaking the Pixel Barrier. (2005) *Proc. Eurographics Workshop Computational Aesthetics in Graphics, Visualization & Imaging*, p 41–48.
49. **Zuk, T**., **Schlesier, L**., **Neumann, P**., **Hancock, M.S**., Carpendale, S. (2006) Heuristics for Information Visualization Evaluation. *Workshop Proceedings of BELIV'06 – Beyond Time and Errors: Novel Evaluation Methods for Information Visualization, ACM Conference on Advanced Visual Interfaces AVI'06*, pages 55–60, ACM Press

50-63 13 papers in ACM & IEEE workshops & organized 3 workshops. Student co-authors in 10/13

Other Refereed Contributions: Videos, Posters, Demos - summary

64-87 14 short papers, posters 5 videos, 3 demos ACM & IEEE conferences. Student co-authors in all

88-99 Independent Papers by HQP under my Supervision including 2 PhD thesis, 5 MSc theses

Articles and Papers in Non-Refereed Publications-summary

100-133. All articles co-authored with students and other HQP under my supervision.

Invited Talks and Panels

134. Carpendale, S. (2005). (keynote talk). Applying Information Visualization to Health Care. At *IASTED International Conference on TELEHEALTH*.
135. Diamond, S., Carpendale, S., Interrante, V., Portway, J., Xin-Wei. S. Panel: Visualization, Semantics & Aesthetics. (2001) *SIGGRAPH*. (also: Information Visualization, London, 2002).

136-178 42 invited talks, panels, including: MIT, Dagstuhl, Concordia University, Dutch Electronic Arts Festival, UCLA, Banff Centre, Stanford University, University of Toronto, Bell Labs, Mitsubishi Electric Research Laboratories, Intel, San Francisco Museum of Modern Art

Patents

179. Elastic Presentation Space. Inventors: M.S.T. Carpendale, D.J. Cowperthwaite, M.H. Tigges, R. Komar, J.F. Bauer, D.J. Baar. Assignee: Advanced Numerical Methods Ltd. (Idelix Software Inc.)

Technology Transfer

Smart Technologies Inc. of Calgary has become very interested in my large display work on sharing information. This has led to my SMART/iCORE Industrial Chair.

Idelix Software Inc. based their primary products on Elastic Presentation [27, 36] and grew rapidly from no paid employees in 1999 to approximately twenty paid employees. Through Idelix, GeoConnections Canada and Boeing Autometric are using EPF based software. A Boeing customer, Atlantic Air Survey Ltd., has announced that they improved productivity 20% with this technology.

Antarctic Waves. I consulted with Braunarts and British Antarctic Survey to create Antarctic Waves, which uses visuals to integrate Antarctic scientific results and sounds to create a tool to inspire musical composition. Won **British Academy of Film and Television Arts, BAFTA,** (see awards).

Intel Inc. sponsored my research for several years and employs my HQP as interns.

Art Gallery Show: i-works was an interactive art/science collaboration art show held: 2003, Nickle Arts Museum, University of Calgary. Well received, attracted considerable media coverage. Nickle Staff told us interest increased as the show continued. (with Dunning, Alberta College of Art & Design)

3. Contributions to the Training of Highly Qualified Personnel

I have established a vibrant research group; currently I have a Post Doctoral fellow, 5 Ph.D. students and 5 MSc students. I actively involve my students in all aspects of my research (invention, creation, planning, design, ethics, studies, development, and implementation), encouraging them to publish and sending them to appropriate conferences. The people who have worked with me (BSc. honours thesis, MSc. Ph.D. Research Assistant) are much in demand and have readily found positions that relate directly to the research they did with me. This includes a Post Doctoral Fellowship at MIT, a tenure track position (starting July 2007), research and development in industry such as SMART Technologies, Idelix Software, Electronic Arts, and continued studies in higher degrees.

4. Other Evidence of Impact and Contribution

2006 **SMART/iCORE Industrial Chair** in Interactive Technologies 2006 (Co-Chair S. Greenberg)
2006 Faculty of Science, **Research Excellence Award**, Faculty of Science, University of Calgary
2004 **Canada Research Chair**, Tier II: Information Visualization
Faculty of Science, Department of Computer Science & Faculty of Communications and Culture
2003 NSERC UFA, University Faculty Award (renewal) (2000 original award)
2002 **BAFTA** (British Academy of Film & Television Arts Interactive Awards)
Category: Interactive Learning, Project: Antarctic Waves: developed with Braunarts and the British Antarctic Survey (a BAFTA is the British equivalent to Canada's GENIE Award or in USA to an Emmy (television) or an Oscar (film))

Recent Positions in Professional Societies:

Editor CG&A Special Issue: Interactive Tabletops; General Chair Computational Aesthetics'07; Video Chair CSCW'06; Posters and Video Chair IEEE Information Visualization'06'05'04; Proceedings Chair, IEEE Information Visualization'03; Program Committee, Information Visualization'02-'06, Graphics Interface'01, '03, '05; Local Organizer and Student Volunteer Chair Graphics Interface'02; Workshop organizer Co-located Tabletop Collaboration, CSCW'02, and Collaboration with Interactive Walls and Tables Workshop at UbiComp'02. Reviewer: approx. 50-60 papers, grants etc per year including NSERC, Alberta Ingenuity, Visualization, Information Visualization, UIST, CHI, SIGGRAPH, Transactions on Visualization, CSCW, Information Design, etc.

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Investir dans les gens, la découverte et l'innovation

SEND ONE ORIGINAL ONLY DO NOT PHOTOCOPY

APPENDIX A
Personal Data
(Form 100)

Complete this appendix (i) if you are an applicant or co-applicant applying for the first time; (ii) if you need to update information submitted with a previous application; or (iii) if you do not hold an appointment at a Canadian postsecondary institution. For updates, include only the revised information in addition to the date, your name and your PIN.

This information will be used by NSERC primarily to contact applicants and award holders. It may also be used to identify prospective reviewers and committee members, and to generate statistics. It will not be seen or used in the adjudication process.

Date: 2007/03/05

Family name	Given name	Initial(s) of all given names	Personal identification no. (PIN)
Carpendale	Sheelagh	MST	146129

Position and complete mailing address if your primary place of employment is not a Canadian postsecondary institution or if your current mailing address is temporary

University of Calgary
2500 University Drive N.W.
Calgary AB T2N 1N4
CANADA

If address is temporary, indicate:

Starting date

Leaving date

Telephone number	Facsimile number	E-mail address
(403) 220-6055	(403) 284-4707	sheelagh@cpsc.ucalgary.ca

Telephone number (alternate)

Give an alternate telephone number only if you can be reached at that number during business hours.

Gender (completion optional): [ ] Male [X] Female

LANGUAGE CAPABILITY

English	Read [X]	Write [X]	Speak [X]
French	Read [ ]	Write [ ]	Speak [ ]

I wish to receive my correspondence: in English [X] in French [ ]

AREA(S) OF EXPERTISE

Provide a maximum of 10 key words that describe your area(s) of expertise. Use commas to separate them. If you have expertise with particular instruments and techniques, specify which one(s).

information visualization, human-computer interaction, Large displays, aesthetic interaction, distortion viewing, computer graphics, information presentation, interaction design, interactive tabletop displays, non-photorealistic rendering

Research subject code(s)

Primary: 2700

Secondary: 2707

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Appendix D (Form 100)
Consent to Provide Limited Personal Information About Highly Qualified Personnel (HQP) to NSERC

NSERC applicants are required to describe their contributions to the training or supervision of highly qualified personnel (HQP) by providing certain details about the individuals they have trained or supervised during the six years prior to their current application. HQP information must be entered on the Personal Data Form (Form 100). This information includes the trainee's name, type of HQP training (e.g., undergraduate, master's, technical etc.) and status (completed, in-progress, incomplete), years supervised or co-supervised, title of the project or thesis, and the individual's present position.

Based on the federal *Privacy Act* rules governing the collection of personal information, applicants are asked to obtain consent from the individuals they have supervised before providing personal data about them to NSERC. In seeking this consent, the NSERC applicant must inform these individuals what data will be supplied, and assure them that it will only be used by NSERC for the purpose of assessing the applicant's contribution to HQP training. To reduce seeking consent for multiple applications, applicants will only need to seek consent one time for a six-year period. If the trainee provides consent by e-mail, the response must include confirmation that they have read and agree to the text of the consent form.

When consent cannot be obtained, applicants are asked to not provide names, or other combinations of data, that would identify those supervised. However, they may still provide the type of HQP training and status, years supervised or co-supervised, a general description of the project or thesis, and a general indication of the individual's present position if known.

An example of entering HQP information on Form 100 (with and without consent):

Name	Type of HQP Training and Status	Years Supervised or Co-supervised	Title of Project or Thesis	Present Position
Consent Received from Marie Roy				
Roy, Marie	Undergraduate (Completed)	Supervised 1994 - 1997	Isotope geochemistry in petroleum engineering	V-P (Research), Earth Analytics Inc., Calgary, Alberta
Consent Not Obtained from Marie Roy				
(name withheld)	Undergraduate (Completed)	Supervised 1994 - 1997	Isotope geochemistry	research executive in petroleum industry - western Canada

Consent Form

Name of Trainee	
Applicant Information	
Name Carpendale, Sheelagh MST	
Department Computer Science	Postsecondary Institution Calgary

I hereby allow the above-named applicant to include limited personal data about me in grant applications submitted for consideration to NSERC for the next six years. This limited data will only include my name, type of HQP training and status, years supervised or co-supervised, title of the project or thesis and, to the best of the applicant's knowledge, my position title and company or organization at the time the application is submitted. I understand that NSERC will protect this data in accordance with the *Privacy Act*, and that it will only be used in processes that assess the applicant's contributions to the training of highly qualified personnel (HQP), including confidential peer review.

_____ _____
Trainee's signature Date

Note: This form must be retained by the applicant and made available to NSERC upon request.

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Investir dans les gens, la découverte et l'innovation

FORM 100
Personal Data Form
PART I

Date: 2007/03/05

Family name	Given name	Initial(s) of all given names	Personal identification no. (PIN)
Greenberg	Saul	S	56717

☐ I hold a faculty position at an eligible Canadian college (complete Appendices B1 and C)

☐ I do not or will not hold an academic appointment at a Canadian postsecondary institution

Place of employment other than a Canadian postsecondary Institution (give address in Appendix A)

APPOINTMENT AT A POSTSECONDARY INSTITUTION

Title of position: Professor

Department: Computer Science

Campus:

Canadian postsecondary institution: Calgary

Tenured or tenure-track academic appointment — Yes [X] No [ ]

Part-time appointment [ ] Full-time appointment [X]

- For all non-tenured or non tenure-track academic appointment and Emeritus Professors, complete Appendices B & C
- For life-time Emeritus Professor and part-time positions, complete Appendix C

ACADEMIC BACKGROUND

Degree	Name of discipline	Institution	Country	Date yyyy/mm
Bachelor's	Microbiology and Immunology	McGill	CANADA	1976 / 04
Master's	Computer Science	Calgary	CANADA	1984 / 05
Doctorate	Computer Science	Calgary	CANADA	1989 / 05
Dip. Ed.	Education	McGill	CANADA	1978 / 04

TRAINING OF HIGHLY QUALIFIED PERSONNEL

Indicate the number of students, fellows and other research personnel that you:

	Currently		Over the past six years (excluding the current year)		
	Supervised	Co-supervised	Supervised	Co-supervised	Total
Undergraduate			5		5
Master's	5		11		16
Doctoral	1		3	1	5
Postdoctoral				1	1
Others	2				2
Total	8		19	2	29

Personal information collected on this form and appendices will be stored in the Personal Information Bank for the appropriate program.
PROTECTED WHEN COMPLETED

Version française disponible

Completed

Personal identification no. (PIN)	Family name
56717	Greenberg

ACADEMIC, RESEARCH AND INDUSTRIAL EXPERIENCE (use one additional page if necessary)

Position held (begin with current)	Organization	Department	Period (yyyy/mm to yyyy/mm)
Professor	Calgary	Computer Science	1989/07
Adjunct Scientist	TR Laboratories	Wireless Communicaton (Calgary)	2003/09 to 2005/09
Senior artist / researcher	Banff Center (Banff, Canada)	Media & Visual Arts Department	2001/06 to 2004/05
Adjunct Professor	University of Saskatchewan	Computer Science	1999/07 to 2009/06
Adjunct Professor	University of Calgary	Psychology (Faculty of Social Sciences)	1998/07 to 2007/06
Visiting Professor	Middlesex University (London, UK)	Faculty of Technology	1996/07 to 2002/12
Consultant	Saul Greenberg Consulting	Various industry sites	1995/01 to 2003/12
Associate Professor	University of Calgary	Computer Science	1993/07 to 1997/06
Course instructor	University of Calgary	Continuing Education	1991/01 to 1998/12

PROTECTED WHEN COMPLETED

ACADEMIC, RESEARCH AND INDUSTRIAL EXPERIENCE (use one additional page if necessary)

Position held (begin with current)	Organization	Department	Period (yyyy/mm to yyyy/mm)
Assistant Professor	University of Calgary	Computer Science	1990/07 to 1993/06
Adjunct Professor	University of Calgary	Computer Science	1989/07 to 1990/06
Head-Learning & Collaboration Group-NSERC Industrial Postdoc	Alberta Research Council	Advanced Technologies	1988/10 to 1990/06
Research associate / Software designer	Various	(contracts)	1980/01 to 1989/05
Teacher	High Schools / Wilderness Schools	(various)	1978/10 to 1980/04

PROTECTED WHEN COMPLETED

Personal identification no. (PIN)	Family name
56717	Greenberg

RESEARCH SUPPORT

Family name and initial(s) of applicant	Title of proposal, funding source and program, and time commitment (hours/month)	Amount per year	Years of tenure (yyyy)
List all sources of support **(including NSERC grants and university start-up funds)** held as an applicant or a co-applicant: a) support held in the past four (4) years but now completed; b) support currently held, and c) support applied for. For group grants, indicate the percentage of the funding directly applicable to your research. Use additional pages as required.			
a) Support held in the past 4 years			
Greenberg, Saul	Groupware places for serious purposes NSERC Operating Grant 20 hours/month	35,000 40,434 40,434 40,434 40,434	1998 1999 2000 2001 2002
Greenberg, Saul	Supporting Awareness in Groupware Microsoft Research, USA Collaborative and Multimedia Systems Research Group 25 hours/month	73,560 112,000 38,462	1999 2000 2001
Sorenson, Paul (PI)	ASERC: The Alberta Software Engineering Consortium Alberta Science and Research Authority 15 hours/month	600,000 (6%) 600,000 (6%) 600,000 (6%)	2000 2001 2002
Greenberg, Saul	Smart Technologies, Canada Hardware/Software donation	14,245	2002

Personal identification no. (PIN)	Family name
56717	Greenberg

RESEARCH SUPPORT

Family name and initial(s) of applicant	Title of proposal, funding source and program, and time commitment (hours/month)	Amount per year	Years of tenure (yyyy)
List all sources of support **(including NSERC grants and university start-up funds)** held as an applicant or a co-applicant: a) support held in the past four (4) years but now completed; b) support currently held, and c) support applied for. For group grants, indicate the percentage of the funding directly applicable to your research. Use additional pages as required.			
a) Support held in the past 4 years			
Greenberg, Saul	DiamondTouch Display Mitshubishi Research Laboratories (MERL), USA Equipment Donation	8,000 8,000	2002 2003
Hewitt (PI) + 6 others	PACE: Prototyping Advanced Collaborative Environments Alberta Science and Research Authority (ASRA) Enabling research application and technology transfer 5 hours/month	125,000 (10%) 125,000 (10%)	2003 2004
Saul Greenberg	Smart Homes TR Laboratories, Canada Adjunct Scientist / student scholarships 5 hours/month	24,000 12,000	2004 2005
b) Support currently held			
Baecker (PI) + 10 others	Network for Effective Collaboration Technologies through Advanced Research NSERC Research Network 40 hours/month	1,100,000 (10%) 1,100,000 (10%) 1,100,000 (10%) 1,100,000 (10%) 1,100,000 (10%)	2004 2005 2006 2007 2008

Personal identification no. (PIN)	Family name
56717	Greenberg

RESEARCH SUPPORT

Family name and initial(s) of applicant	Title of proposal, funding source and program, and time commitment (hours/month)	Amount per year	Years of tenure (yyyy)
List all sources of support **(including NSERC grants and university start-up funds)** held as an applicant or a co-applicant: a) support held in the past four (4) years but now completed; b) support currently held, and c) support applied for. For group grants, indicate the percentage of the funding directly applicable to your research. Use additional pages as required.			
b) Support currently held			
Greenberg, Saul	An Emboddied Groupware Environment NSERC Discovery Grant 40 hours/month	49,700 49,700 49,700 49,700 49,700	2004 2005 2006 2007 2008
Greenberg, Saul	iCORE / Smart Technologies Chairs in Interactive Technologies iCORE Industrial Chair Establishment Grants 40 hours/month	200,000 (50%) 200,000 (50%) 200,000 (50%) 200,000 (50%) 200,000 (50%)	2007 2008 2009 2010 2011

PROTECTED WHEN COMPLETED

Highly Qualified Personnel (HQP)

Provide personal data about the HQP that you currently, or over the past six years, have supervised or co-supervised.

Personal identification no. (PIN)	Family name
56717	Greenberg

Name	Type of HQP Training and Status	Years Supervised or Co-supervised	Title of Project or Thesis	Present Position
Au Yeung, Tim	Master's (In Progress)	Supervised 2007 -	In progress	MSc Student, U Calgary
Neustaedter, Carman	Res. Associate	Supervised 2007 -	Domestic Computing	Post-doc equivalent position
Watson, Mark	Res. Associate (In Progress)	Supervised 2006 -	Software Infrastructures for Groupware/Ubiquitous Computing	Research Associate, U Calgary
Tse, Edward	Doctoral (In Progress)	Supervised 2005 -	Multi-user, Multimodal Interaction over Digital Tables	PhD Student, U Calgary; also MERL intern
Diaz-Marino, Roberto	Master's (In Progress)	Supervised 2004 -	Cambience: A Sonic Ecology from Video	MSc Student, U Calgary; Also independant consultant
Smale, Stephanie	Master's (In Progress)	Supervised 2004 -	Transient Life	MSc Student, U Calgary
Tee, Kimberley	Master's (In Progress)	Supervised 2004 -	Awareness through Shared Desktoops	MSc Student, U Calgary; Also Microsoft Research Intern
Tse, Edward	Master's (Completed)	Supervised 2002 -	Rapidly Prototyping Single Display Groupware	continued on as PhD Student; also Smart Tech. Intern
Fitchett, Chester	Master's (Not Completed)	Supervised 2001 -	Phidgets: A Toolkit for Computer-Controlled Physical	Tech Transfer: Founder and President, Phidgets Inc., Calgary
Birnholtz, Jeremy	Postdoctoral (Completed)	Co-supervised 2005 - 2007	Nectar Social Science Research	Faculty member, US University
Nunes, Michael	Master's (In Progress)	Supervised 2005 - 2007	Information exchange in domestic environments	MSc Student, Computer Science
Neustaedter, Carman	Doctoral (Completed)	Supervised 2003 - 2007	Domestic Awareness and the Role of Family Calendars.	Interned at MSR; now Postdoc equivalent Research Associate
Marquardt, Nicolai	Undergraduate (In Progress)	Supervised 2005 - 2006	Shared Phidgets	Diplom Student, Bauhaus University Germany. Also MSR
Elliot, Kathryn	Master's (Completed)	Supervised 2003 - 2006	Contextual Locations in the Home	interned at MSR; now Smart Technologies Inc. employee
Tang, Charlotte	Doctoral (In Progress)	Co-supervised 2003 - 2006	Shift Changes in Hospital Environments	Switched fulll time to co-supervisor Carpendale
McEwan, Gregor	Master's (Completed)	Supervised 2002 - 2006	Community Bar: Designing for Casual Interaction	Researcher, National ICT Australia
Tang, Anthony	Master's (Completed)	Supervised 2002 - 2005	Mixed Presence Groupware	conintued on as PhD student, UBC
Boyle, Michael	Doctoral (Completed)	Supervised 1999 - 2005	Privacy in Video Media Spaces	Also MSR Intern; now at Smart Technologies, Calgary
Rounding, Michael	Master's (Completed)	Supervised 2000 - 2004	The Notification Collage: A Public Awareness Space for Work	HCI Specialist, Smart Technologies, Calgary
Agarawala, Ananad	Undergraduate (Completed)	Supervised 2003 - 2003	Context aware device for medication management	NSERC USRA, now MSc student, U Toronto

Highly Qualified Personnel (HQP)

Provide personal data about the HQP that you currently, or over the past six years, have supervised or co-supervised.

Personal identification no. (PIN)	Family name
56717	Greenberg

Name	Type of HQP Training and Status	Years Supervised or Co-supervised	Title of Project or Thesis	Present Position
Elliot, Kathryn	Undergraduate (Completed)	Supervised 2003 - 2003	Flexible ambient displays	Continued as MSc Student
Neustaedter, Carman	Master's (Completed)	Supervised 2001 - 2003	Balancing Privacy and Awareness in a Home Media Space	also MSR Intern; Continued as a PhD student
Tang, Charlotte	Master's (Completed)	Supervised 2001 - 2003	Multimedia Histories of Casual Interaction	Continued as a PhD student
Zanella, Ana	Doctoral (Not Completed)	Supervised 1999 - 2003	Interference in Single Display Groupware	Career change - now in Arts and Design School
Tse, Edward	Undergraduate (Completed)	Supervised 2001 - 2002	Tookit Infrastructures	Continued as MSc then PhD Student
Tam, James	Master's (Completed)	Supervised 1999 - 2002	Supporting Change Awareness in Visual Workspaces	Instructer II (Academic), University of Calgary
Baker, Kevin	Master's (Completed)	Supervised 1998 - 2002	Heuristic Evaluation of Shared Workspace Groupware	Human Factors Engineer - Greenley and Associates
Tang, Charlotte	Undergraduate (Completed)	Supervised 2001 - 2001	VisStreams	Continued as an MSc and PhD Student
Kaasten, Shaun	Master's (Completed)	Supervised 1998 - 2001	Integrating Back, History and Bookmarks in Web Browsers	HCI Specialist, General Dynamics, Calgary

1. Most Significant Research Contributions

My work is well-known, heavily cited (H-index = 40), and regularly exploited by the Human Computer Interaction (HCI) and CSCW (Computer Supported Cooperative Work) community. I am listed 9th in the HCI bibliography's 'most frequent authors' list. In recognition of my research, I have been inducted into the ACM CHI Academy (2005), was honoured with a University Professorship by the University of Calgary for research excellence (2006), and was just awarded an iCORE Industrial Chair (Fall, 2006).

Social aspects of groupware. We investigate social aspects of groupware and use the results to inform system requirements and design. For example, our past empirically-based framework on ***Workspace Awareness*** as well as the suite of interaction techniques we developed from it is heavily cited. Current work in ***casual interaction***, ***context awareness, domestic computing*** and ***tabletop interaction*** is gaining similarly exposure, citations and use, where this work directly influenced the formation of a central theme within the NECTAR NSERC Research Network. Both areas led to funding and/or direct working relationships with prominent industries - Smart Technologies, Microsoft Research, MERL - and involvement with TR Laboratories.

Toolkits and systems. We contribute research infrastructures and toolkits that make it easy to rapidly prototype advanced user interfaces. Our ***Phidgets*** hardware/software toolkit lets everyday programmers rapidly design physical interfaces using computer-controlled physical devices. It received best paper award at 1st-tier ACM UIST 2001. Various top Universities use Phidgets for research and teaching, and the successful spin-off company Phidgets Inc. was formed. Our ***.Networking*** and ***Collabrary*** toolkits provide the basis of rapidly prototyping distributed multimedia groupware. ***GroupKit*** is mature toolkit for synchronous and distributed groupware; it is cited as a base-line standard in papers concerning real time groupware architectures. ***SDGToolkit***, for developing Single Display Groupware led to joint research with Smart Technologies Inc. and MERL USA.

2. Other Research Contributions in the last Six Years. *Student authors are marked in* ***bold font****.*

Full Papers in Refereed Journals

ACM TOCHI, *Human-Computer Interaction*, and *Computer Supported Cooperative Work* are top tier journals in my discipline, with *Int J Human Computer Studies* closely behind.

1. Greenberg, S. (2007) Toolkits & Interface Creativity. *J Multimedia Tools & Applications,* 32(2).
2. **Neustaedter**, C., Greenberg, S. & **Boyle**, M. (2006). Blur Filtration Fails to Preserve Privacy for Home-Based Video Conferencing. *ACM TOCHI Trans. Human Computer Interaction, 13(1).*
3. **Tam**, J., and Greenberg, S. (2006) A Framework for Asynchronous Change Awareness in Collaborative Documents and Workspaces. *Int J. Human Computer Studies,* 64(7), Elsevier.
4. **Boyle**, M. & Greenberg, S. (2005) The Language of Privacy: Learning from Video Media Space Analysis and Design. *ACM TOCHI Trans. Human Computer Interaction* 12(2).
5. **Tang**, A., **Boyle**, M. and Greenberg, S. (2005). Display and Presence Disparity in Mixed Presence Groupware. J. Research and Practice in Information Technology, Vol. 37, No. 2, May, 71-88.
6. **Kruger**, R., Carpendale, S. **Scott**, S. & Greenberg, S. (2004) Roles of Orientation in Tabletop Collaboration. *J Computer Supported Cooperative Work*, 12(5-6). Kluwer.
7. **Pinelle**, D., Gutwin, C. & Greenberg, S. (2003) Task Analysis for Groupware Usability Evaluation: Modeling Shared-Workspace Tasks with the Mechanics of Collaboration. *ACM TOCHI* 10(4) ACM.
8. Cockburn, A., Greenberg, S. Jones, S., McKenzie, B. & **Moyle**, M. (2003) Improving WEB Page Revisitation: Analysis, Design and Evaluation. *IT & Society Journal,* **3**(1), 159-183, Winter, SIQSS.
9. **Gutwin**, C., & Greenberg, S. (2002) A Descriptive Framework of Workspace Awareness for Real-Time Groupware. *Computer Supported Cooperative Work*, 11(3-4), 411-446, Kluwer.
10. Greenberg, S. (2001) Context as a dynamic construct. *Human-Computer Interaction,* 16 (2-4), LEA

Full Papers in Fully Refereed Conferences/Symposium Proceedings

ACM CHI, CSCW, UIST, UBICOMP, AVI conferences are 1st-tier. Most acceptance rates ~20%.

11. Cockburn, A., Gutwin, C. and Greenberg, S. (2007). A Predictive Model of Menu Performance. Proc ACM CHI'07, ACM Press.
12. **Elliot**, K., **Neustaedter**, C. and Greenberg, S. (2007). StickySpots: Using Location to Embed Technology in the Social Practices of the Home. *Proc. TEI'07 Tangible and Embedded Interaction.*
13. Marquardt, N. and Greenberg, S. (2007). Distributed Physical Interfaces with Shared Phidgets. *Proc. TEI'07 Tangible and Embedded Interaction.*
14. **Neustaedter**, C., Brush, A.J. and Greenberg, S. (2007) A Digital Family Calendar in the Home: Lessons from Field Trials of LINC. *Proc. Graphics Interface*.
15. **Tse**, E., Shen, C., Greenberg, S. and Forlines, C. (2007). How Pairs Interact Over a Multimodal Digital Table. *Proc. ACM CHI'07,* ACM Press. (Tech Note).
16. Greenberg, S. and **Boyle**, M. (2006) Generating Custom Notification Histories by Tracking Visual Differences between Web Page Visits. *Proc Graphics Interface (GI'06),* June, 227-234.
17. **Hancock**, M., Miller, J., Greenberg, S. and Carpendale, S. (2006) Exploring Visual Feedback of Change Conflict in a Distributed 3D Environment. *Proc AVI'06*, ACM Press, 209-216.
18. **McEwan**, G., Greenberg, S., **Rounding**, M. and **Boyle**, M. (2006) Groupware Plug-ins. Proc 2nd Int'l Conf on Collaboration Technologies (CollabTech'06), IPSJ SIG, 42-47. **Best paper nominee**.
19. **Neustaedter**, C., **Elliot**, K. and Greenberg, S. (2006) Interpersonal Awareness in the Domestic Realm. *Proc. OZCHI*. 8 pages.
20. **Smale**, S. and Greenberg, S. (2006) Transient Life: Collecting and sharing personal information. *Proc. OZCHI*. 8 pages.
21. **Tang**, A., **Neustaedter**, C. and Greenberg, S. (2006) VideoArms: Embodiments for Mixed Presence Groupware. *Proc 20th British HCI (BHCI) Group Conference,* British Computer Society. 16 pages.
22. **Tee**, K., Greenberg, S. and Gutwin, C. (2006) Providing Artifact Awareness to a Distributed Group through Screen Sharing. *Proc ACM CSCW'06,* ACM Press.
23. **Tse**, E., Shen, C., Greenberg, S. and Forlines, C. (2006) Enabling Interaction with Single User Applications through Speech and Gestures on a Multi-User Tabletop. *Proc AVI'06*, ACM, 336-343.
24. **Tse**, E., Greenberg, S. and Shen, C. (2006) GSI DEMO: Multiuser Gesture / Speech Interaction over Digital Tables by Wrapping Single User Applications. *Proc 8th ICMI'06*, ACM Press.
25. **Tse**, E., Greenberg, S., Shen, C. and Forlines, C. (2006) Multimodal Multiplayer Tabletop Gaming. *Proc 3rd Int'l Workshop on Pervasive Gaming Applications (PerGames'06),* 139-148.
26. **Boyle**, M. and Greenberg, S. (2005) Rapidly Prototyping Multimedia Groupware. Proc DMS'05.
27. **Elliot**, K., **Neustaedter**, C. and Greenberg, S. (2005) Time, Ownership and Awareness: The Value of Contextual Locations in the Home. *Proc UBICOMP 2005*, LNCS 3660, p251-268, Springer.
28. **McEwan**, G., and Greenberg, S. (2005) Supporting Social Worlds with the Community Bar. *Proc ACM Group'05*, ACM Press, 21-30.
29. **Smale**, S. and Greenberg, S. (2005) Broadcasting Information via Display Names in Instant Messaging. *Proc ACM Group* 2005, ACM Press, 89-98.
30. **Tam**, J. and Greenberg, S. (2004) A Framework for Asynchronous Change Awareness in Collaboratively-Constructed Documents. *CRIWG Int'l Workshop Groupware*, LNCS 3198, Springer
31. **Tse**, E., **Histon**, J., **Scott**, S. and Greenberg, S. (2004). Avoiding Interference: How People Use Spatial Separation and Partitioning in SDG Workspaces. *Proc ACM CSCW'05,* ACM Press.
32. **Tse**, E. and Greenberg, S. (2004) Rapidly Prototyping Single Display Groupware through the SDGToolkit. *Proc 5th Australasian User Interface Conference,* ACS, p101-110.
33. **Kruger**, R., Carpendale, S., **Scott**, S. & Greenberg, S. (2003). How People Use Orientation on Tables. *Proc ACM Group 2003 Int'l Conference on Supporting Group Work*, ACM Press.
34. **Neustaedter**, C. & Greenberg, S. (2003) The Design of a Context-Aware Home Media Space. *Proc UBICOM*'03 5th Int'l Conference on Ubiquitous Computing. LNCS Series, Springer-Verlag.
35. **Tang**, C., **McEwan**, G. & Greenberg, S. (2003) A Taxonomy of Tasks and Visualizations for Casual Interaction of Multimedia Histories. *Proc Graphics Interface,* 225-236. Morgan-Kaufmann.

36. **Wong**, N., Carpendale, S. & Greenberg, S. (2003) EdgeLens: An Interactive Method for Managing Edge Congestion in Graphs. *INFOVIS'03 Proc IEEE Symp. Information Visualization*.
37. **Baker**, K., Greenberg, S. & Gutwin, C. (2002) Empirical development of a heuristic evaluation methodology for shared workspace groupware. *Proc ACM CSCW'02*, 96-105, ACM Press.
38. Greenberg, S. & **Boyle**, M. (2002) Customizable physical interfaces for interacting with conventional applications. *Proc ACM UIST Symp. User Interface Software & Technology*, 31-40.
39. **Kaasten**, S., Greenberg, S. & **Edwards**, C. (2002) How People Recognize Previously Seen WWW Pages from Titles, URLs and Thumbnails. *People and Computers XVI (Proc BHCI)*, Springer.
40. **Baker, K.,** Greenberg, S. & Gutwin, C. (2001) Heuristic Evaluation of Groupware Based on the Mechanics of Collaboration. *Proc Engineering for HCI*, 123-139, LNCS 2254, Springer-Verlag.
41. Greenberg, S. & **Rounding, M**. (2001) The Notification Collage: Posting Information to Public and Personal Displays. *Proc ACM CHI Conf. on Human Factors in Computing Systems*, 515-521.
42. Greenberg, S. & **Fitchett, C.** (2001) Phidgets: Easy Development of Physical Interfaces through Physical Widgets. *Proc ACM UIST'01*, 209-218**,** *ACM Press.* **Best Paper award**.
43. Steves, M.P., Morse, E., Gutwin, C. & Greenberg, S. (2001). A Comparison of Usage Evaluation and Inspection Methods for Assessing Groupware Usability. *Proc ACM Group'01*, ACM, 125-134.
44. **Zanella, A**. & Greenberg, S. (2001) Reducing Interference in Single Display Groupware through Transparency. *Proc ECSCW European Conf. Computer Supported Cooperative Work*, 20p, Kluwer.

Short Papers / Posters / Demonstrations in Fully Refereed Conferences/Symposium Proceedings

45. **Diaz-Marino**, R. and Greenberg, S. (2006). Demonstrating How to Construct a Sonic Ecology for Media Spaces through Cambience. Demo + 2 page paper, *Adjunct Proc ACM CSCW*.
46. **Isenberg**, T., **Neumann**, P., Carpendale, S., **Nix**, S. and Greenberg , S. (2006). Interactive Annotations on Large, High-Resolution Information Displays. Poster, *IEEE InfoVis*.
47. **Neustaedter**, C., Brush, A.J. and Greenberg, S. (2006). A Demo of Family Calendaring using LINC. Demo + 2 page paper, *Adjunct Proc ACM CSCW*.
48. **Nunes**, M., Greenberg, S., Carpendale, S. and Gutwin, C. (2006). Demonstrating Timeline: Video Traces for Awareness. Demo + 2 page paper, *Adjunct Proc ACM CSCW*.
49. **Tee**, K., Greenberg, S., McEwan, G. and Gutwin, C. (2006). Sharing Desktops with the Community Bar. Demo + 2 page paper, *Adjunct Proc ACM CSCW*.
50. **Tse**, E., Greenberg, S., Shen, C. (2006). Multi User Multimodal Tabletop Interaction over Existing Single User Applications. Demo + 2 page paper, *Adjunct Proc ACM CSCW*.
51. **Tse**, E., Greenberg, S., Shen, C. (2006). Exploring Interaction with Multi User Speech and Whole Handed Gestures on a Digital Table. Demo + 2 page paper, *Adjunct Proc ACM UIST*.
52. **Young**, J., **McEwan**, G., Greenberg, S. and Sharlin, E. (2006). Aibo Surrogate - A Group-Robot Interface. Demo + 2 page paper, *Adjunct Proc ACM CSCW*.
53. **Tee**, K., Carpendale, S. and Greenberg, S. Visualizing Online Interaction. *IEEE InfoVis'05*
54. **Diaz-Marino**, R.A., Tse, E, & Greenberg, S. (2003) Programming for Multiple Touches and Multiple Users. *Companion Proc ACM UIST'03 Conf. User Interface Software and Technology.*
55. **Tse**, E. & Greenberg, S. (2002) SDGToolkit: A Toolkit for Rapidly Prototyping Single Display Groupware. *Poster in ACM CSCW '2002 Conference on Computer Supported Cooperative Work.*
56. **Kruger**, R., Carpendale, S. & Greenberg, S. (2002) Collaborating over Physical and Electronic Tables. Poster in *ACM CSCW '2002* Conference on Computer Supported Cooperative Work.
57. **Kaasten, S.** & Greenberg, S. (2001) Integrating Back, History and Bookmarks in Web Browsers. *ACM CHI Extended Abstracts of the Conf. of Human Factors in Computing Systems*, 379-380.
58. **Zanella, A.** & Greenberg, S. (2001) Avoiding Interference through Translucent Interface Components in Single Display Groupware. *ACM CHI Extended Abstracts*, 375-376.

Videotapes in Fully-Refereed Video Journals/Proceedings *(usually includes 2 page summary)*

59-65. The videos below were published in *Video Proceedings, ACM CSCW'06.*

- **Diaz-Marino**, R. and Greenberg, S. Cambience: A Video-Driven Sonic Ecology for Media Spaces.
- **Elliot**, K., **Neustaedter**, C. Greenberg, S. (2006) Sticky Spots: A Location-Based Messaging System
- Greenberg, S. and **Tse**. E. (2006) SDGToolkit in Action.
- **Neustaedter**, C., Brush, A.J. and Greenberg, S. (2006) LINC, An Inkable Digital Family Calendar:
- **Nunes**, M., Greenberg, S., Carpendale, S., Gutwin, C. (2006) Timeline-Video Traces for Awareness.
- **Tee**, K., Greenberg, S., Gutwin, C. and **McEwan**, G. (2006) Shared Desktop Media Item
- **Tse**, E., Greenberg, S., Shen, C. (2006) Motivating Multimodal Interaction around Digital Tabletops.

66. **McEwan, G**. and Greenberg, S. (2005) Community Bar (The Video). *Video Proc ECSCW'05.*
67. **Tang, A., Pattison, E.** and Greenberg, S. (2005). DartMail: *Video Proc ECSCW'05.*
68. **Agarawala**, A., Greenberg, S. and **Ho**, G. (2004) The Context-Aware Pill Bottle and Medication Monitor. *Video Proc / Supplement UBICOMP 2004 Conference.*
69. **Diaz-Marino**, R., **Tse**, E. and Greenberg. S. (2004) The Grouplab DiamondTouch™ Toolkit. *Video Proc ACM Conf. CSCW*, ACM Press.
70. **Elliot**, K. and Greenberg, S. (2004) Building Flexible Displays for Awareness and Interaction. *Video Proc / Supplement UBICOMP 2004 Conference*.
71. **Tang**, A., **Neustaedter**, C. and Greenberg, S. (2004) VideoArms: Supporting Remote Embodiment in Groupware. *Video Proc ACM Conf. CSCW*, ACM Press.
72. **Tse**, E. and Greenberg. S. (2004) SDG Toolkit. *Video Proc ACM Conf. CSCW,* ACM Press.
73. **Neustaedter**, C. & Greenberg, S. (2003) The Design of a Context-Aware Home Media Space. *Video Proc of UBICOM 2003 5th Int'l Conference on Ubiquitous Computing.*
74. **Wong**, N., Carpendale, S. and Greenberg, S. (2003). EdgeLens: An Interactive Method for Managing Edge Congestion in Graphs (The Video). Video Proc IEEE INFOVIS'03.
75. **Neustaedter**, C., Greenberg, S. & Carpendale, S. (2002) IMVis: Instant Messenger Visualization. *Video Proc of the ACM Conf. CSCW*, ACM Press.

Invited Chapters in Books

76. Greenberg, S. (In Press). Observing Collaboration: Group-Centered Design. In: T. Erickson and D. W. McDonald, *HCI Remixed: Reflections on Notable HCI Papers*, MIT Press.
77. Greenberg, S. (2005) Collaborative Physical User Interfaces. In K. Okada, T. Hoshi, and T Inoue (Eds) *Communication and Collaboration Support Systems*, IOS Press. 24-42.
78. Greenberg, S. (2003) Working through Task-Centered System Design. in Diaper, D. & Stanton, N. (Eds) *The Handbook of Task Analysis for Human-Computer Interaction.* LEA Press.
79. **Gutwin**, C., & Greenberg, S. (2004) The Importance of Awareness for Team Cognition in Distributed Collaboration. In E. Salas and S. M. Fiore (Editors) *Team Cognition: Understanding the Factors that Drive Process and Performance*, 177-201, Washington:APA Press.
80. Greenberg S. & Roseman, M. (2003). Using a Room Metaphor to Ease Transitions in Groupware. In M. Ackerman, V. Pipek, V. Wulf (Eds) *Sharing Expertise: Beyond Knowledge Management,* 203-256, January, Cambridge, MA, MIT Press.

Invited Publications Associated with Keynote and Plenary talks

81. Greenberg, S. (2006) Reconsidering HCI in the age of social, ubiquitous and domestic computing. (Invited Plenary). *Interaccion'06: VII Congreso Intern'l de Interaccion Personal-Ordenador.*
82. Greenberg, S. (2004) Physical User Interfaces: What they are and how to build them. (Invited survey) *ACM UIST'04 Symposium on User Interface Software and Technology.*
83. Greenberg, S. (2004). Enhancing Creativity with (Groupware) Toolkits. *Proc Fifth Australasian User Interface Conference*, Australian Computer Society Inc., p3.
84. Greenberg, S. (2003) Enhancing Creativity with Groupware Toolkits. (Invited Keynote) *Proc. CRIWG ' 2003 9th Int'l Workshop on Groupware*, LNCS series, 9 pages, Springer-Verlag.
85. Greenberg, S. (2002) Rapid Prototyping of Physical User Interfaces (Invited Plenary). *Proceedings of Graphics Interface* (GI'2002), 3 pages, Distributed by ACM and Morgan-Kaufmann, May.

86. Greenberg, S. (2001) Supporting Casual Interaction between Intimate Collaborators (Invited Keynote) 3, *Engineering for Human-Computer Interaction*, LNCS Vol 2254, Springer-Verlag.

Others.

87 - 98. **Invited workshops papers** (mostly ACM) refereed by Workshop Committees
99 -110. **Theses** produced by people under my supervision.
111-121. **Independent papers** produced by people under my supervision.
122-138. **Non-refereed publications**, all including student authors.

Technology Transfer

- **Phidgets Inc.**, a spin-off company led by student Fitchett, commercialises our Phidgets research.
- **Microsoft Research** sponsored my research for several years. They employ my HQP as interns.
- **Smart Technologies Inc.** of Calgary maintains a constant interest in our work. It led to the iCORE Research Chair, a PACE grant, and funding of a major NECTAR NSERC Network Grant.
- **TR Laboratories** appointed me as Adjunct Scientist, and funded several students for related work.

3. Contributions to the Training of Highly Qualified Personnel

I train students to publish/present their work, evident by the high number of bolded student authors. Microsoft Research, MERL and Smart Technologies recruit my HQP as research interns. SMART Technologies have hired several of my HQP in strong positions. Former MSc student Tam is a tenure-track University Instructor. Student Fitchett formed a company exploiting their research.

4. Other Evidence of Impact and Contributions

Major Awards

- **iCORE Industrial Chair** – Awarded Fall 2006 for 5 years (with Sheelagh Carpendale)
- **University of Calgary University Professorship** – Awarded 2006 "for research excellence".
- **ACM CHI Academy** – Awarded and Indicted 2005: "an honorary group of individuals who have made extensive contributions to the study of HCI and who have led the shaping of the field".|

Major Academic Community Service

- **Panel Member**, EPSRC International Review of ICT (UK) (2007)
- **Chair**, NSERC CRC Review Committee (2005)
- **Chair**, NSERC GSC-330 (2003) and **Member**, NSERC GSC-330 (2002)
- **Chair**, Selection committee for Editor in Chief, ACM Trans Human Computer Interaction (2003)
- **Member**, ACM CHI Publications Board (many years, now completed)
- **Referee** many academic tenure and promotion cases and grant applications.

Major Journal Affiliations

- **Associate Editor**, CSCW Journal, Kluwer Press since its conception.
- **Editorial Board Member** for the International Journal of Human Computer Studies since 1988.

Major Conference Affiliations

- ACM CHI Conference on Human Factors in Computing Systems:
  - **Associate Chair** of the technical papers program committee (2003, 2001, 1998)
  - **Member**, technical papers committee (every year since 1990), video committee (1998)
- ACM CSCW Conference on Computer Supported Cooperative Work:
  - **Co-Chair**, technical papers committee (2006, 1998)

Program Committees and Other Referee involvements

- I regularly serve as a PC member and referee approximately 60-70 conference + journal papers /year

Invited talks

- **Plenary/keynote speaker** for: HCIEd (2007), Interaacion (2006), UIST survey (2004), 5th AUIC Conference (2004), CRIWG Int'l Conf on Groupware 2003, Graphics Interface 2002, and others
- **Invited speaker** at U. Washington, Microsoft Research Laboratories, ACM CAPCHI, Banff New Media Institute, many seminars at universities (including distinguished speaker) and industry, etc.

Grant Theme Leader for NSERC Research Networks Grant (a 5.5 million dollar CDN 5 year grant).

NSERC CRSNG *Investing in people, discovery and innovation*
Investir dans les gens, la découverte et l'innovation

SEND ONE ORIGINAL ONLY DO NOT PHOTOCOPY

APPENDIX A
Personal Data
(Form 100)

Complete this appendix (i) if you are an applicant or co-applicant applying for the first time; (ii) if you need to update information submitted with a previous application; or (iii) if you do not hold an appointment at a Canadian postsecondary institution. For updates, include only the revised information in addition to the date, your name and your PIN.

This information will be used by NSERC primarily to contact applicants and award holders. It may also be used to identify prospective reviewers and committee members, and to generate statistics. It will not be seen or used in the adjudication process.

Date: 2007/03/05

Family name	Given name	Initial(s) of all given names	Personal identification no. (PIN)
Greenberg	Saul	S	56717

Position and complete mailing address if your primary place of employment is not a Canadian postsecondary institution or if your current mailing address is temporary

If address is temporary, indicate:

Starting date

Leaving date

Telephone number	Facsimile number	E-mail address
403 (220) 6087	(284) 4707	saul@cpsc.ucalgary.ca

Telephone number (alternate)

Give an alternate telephone number only if you can be reached at that number during business hours.

Gender (completion optional): [X] Male [ ] Female

LANGUAGE CAPABILITY

English	Read [X]	Write [X]	Speak [X]
French	Read [ ]	Write [ ]	Speak [ ]

I wish to receive my correspondence: in English [X] in French [ ]

AREA(S) OF EXPERTISE

Provide a maximum of 10 key words that describe your area(s) of expertise. Use commas to separate them. If you have expertise with particular instruments and techniques, specify which one(s).

Human computer interaction, computer supported cooperative work, groupware, user interface software technology, context-aware computing, ubiquitous computing, domesitc computing

Research subject code(s)

Primary: 2700

Secondary: 2710

Appendix D (Form 100)
Consent to Provide Limited Personal Information About Highly Qualified Personnel (HQP) to NSERC

NSERC applicants are required to describe their contributions to the training or supervision of highly qualified personnel (HQP) by providing certain details about the individuals they have trained or supervised during the six years prior to their current application. HQP information must be entered on the Personal Data Form (Form 100). This information includes the trainee's name, type of HQP training (e.g., undergraduate, master's, technical etc.) and status (completed, in-progress, incomplete), years supervised or co-supervised, title of the project or thesis, and the individual's present position.

Based on the federal *Privacy Act* rules governing the collection of personal information, applicants are asked to obtain consent from the individuals they have supervised before providing personal data about them to NSERC. In seeking this consent, the NSERC applicant must inform these individuals what data will be supplied, and assure them that it will only be used by NSERC for the purpose of assessing the applicant's contribution to HQP training. To reduce seeking consent for multiple applications, applicants will only need to seek consent one time for a six-year period. If the trainee provides consent by e-mail, the response must include confirmation that they have read and agree to the text of the consent form.

When consent cannot be obtained, applicants are asked to not provide names, or other combinations of data, that would identify those supervised. However, they may still provide the type of HQP training and status, years supervised or co-supervised, a general description of the project or thesis, and a general indication of the individual's present position if known.

An example of entering HQP information on Form 100 (with and without consent):

Name	Type of HQP Training and Status	Years Supervised or Co-supervised	Title of Project or Thesis	Present Position
Consent Received from Marie Roy				
Roy, Marie	Undergraduate (Completed)	Supervised 1994 - 1997	Isotope geochemistry in petroleum engineering	V-P (Research), Earth Analytics Inc., Calgary, Alberta
Consent Not Obtained from Marie Roy				
(name withheld)	Undergraduate (Completed)	Supervised 1994 - 1997	Isotope geochemistry	research executive in petroleum industry - western Canada

Consent Form

Name of Trainee

Applicant Information

Name Greenberg, Saul S

Department	Postsecondary Institution
Computer Science	Calgary

I hereby allow the above-named applicant to include limited personal data about me in grant applications submitted for consideration to NSERC for the next six years. This limited data will only include my name, type of HQP training and status, years supervised or co-supervised, title of the project or thesis and, to the best of the applicant's knowledge, my position title and company or organization at the time the application is submitted. I understand that NSERC will protect this data in accordance with the *Privacy Act*, and that it will only be used in processes that assess the applicant's contributions to the training of highly qualified personnel (HQP), including confidential peer review.

Trainee's signature _____ Date _____

Note: This form must be retained by the applicant and made available to NSERC upon request.