An Innovation Strategy for Memorial University of Newfoundland

Office of the Vice-President (Research)

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Executive Summary

Universities play an essential role in advancing the innovative fabric and economic performance of developed economies. Most notably, while contributing toward the development of a competent, skilled, and adaptable workforce, they drive innovation by providing an environment that encourages novel solutions or approaches to existing challenges, and by fostering collaborations with industry.

In order to ensure that Memorial University is positioned to maximize its contributions, a process was initiated to examine Memorial's performance on innovation-related outcomes and to develop a supporting strategy. This strategy is intended to help guide Memorial in creating one of the most progressive innovative environments in Canada and is supported by its Vision, which states:

> *"Memorial University will be one of the most distinguished public universities in Canada and beyond, and will fulfill its special obligation to the people of Newfoundland and Labrador."*

The development of this Innovation Strategy began in October 2014 and relied upon broad consultations with stakeholders as well as a review of current literature and best practices. During consultations, stakeholders clearly articulated a desire for Memorial to increase its contributions towards advancing the economy of the Province of Newfoundland and Labrador. To accomplish this, it is recommended that Memorial implement a detailed action plan aiming to:

1. Foster a culture of innovation,
2. Revise and implement its policies in support of innovation,
3. Establish responsive business structures and processes, and
4. Ensure adequate oversight and guidance of its innovative structures and processes.

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1.0 Introduction

Universities play an essential role in advancing the innovative fabric and economic performance of developed economies. Most notably, while contributing toward the development of a competent, skilled, and adaptable workforce, they drive innovation by providing an environment that encourages novel solutions or approaches to existing challenges, and by fostering collaborations with industry.

The Conference Board of Canada has highlighted Canada's innovation performance as an area of concern and indicates that its "global competitiveness ranking continues to slide". The Conference Board of Canada also suggests that "Canada must also do more to strengthen its research institutions, university-industry partnerships, and cluster developments" [1]. In addition to Memorial's role in contributing to Canada's global competitiveness, it also has a special obligation to the Province of Newfoundland and Labrador and to its citizens. Memorial's development of an Innovation Strategy at a time of significant volatility in the price of crude is timely as it has highlighted the need for economic diversity in Newfoundland and Labrador and the need for the University to play a leading role in diversification.

Generally, an "innovation" is considered to be something that is novel or new - a new process, idea or device. For the purpose of this document, the concept of "innovation" is associated with the creation of economic value from intellectual property (IP) through its assignment, sale or licensing to an outside organization, or via the creation of spin-off companies. At Memorial, much of the research related to innovation is undertaken as applied research and development, either in collaboration with an organization that would like to use the IP for commercial outcomes, or through its financial support. Even so, research with commercial potential often follows from fundamental, curiosity-based research that does not set out to address particular commercialization opportunities. The present Innovation Strategy makes recommendations on specific actions that will allow Memorial to strengthen its contribution to the economic competitiveness of the Province of Newfoundland and Labrador, and create one of the most progressive university innovation environments in Canada.

2.0 The Process to Develop this Innovation Strategy

In October, 2014, a process was initiated to examine Memorial's performance on commercialization-related outcomes and develop a strategy to support enhanced performance.

First, best practices and policies from select Canadian Universities were reviewed, as were a number of related reports and applicable studies.

Then, extensive consultations were conducted with a wide range of stakeholders. More than 100 industry associations, government agencies and industrial partners were invited to participate in consultation sessions. Input was also requested from all of Memorial's Faculties, Schools and Campuses. Written submissions were received in addition to 60 consultation sessions with funding agencies, industry associations, private sector research partners, Genesis Board members, Genesis clients, the

Marine Institute, Grenfell Campus, the Faculty of Medicine, the School of Pharmacy, the Faculty of Business, the Faculty of Engineering and Applied Science, the Faculty of Science, the Faculty of Arts and the Labrador Institute.

Typically, the consultation sessions began with an overview of the objectives. Participants were then invited to provide input on any or all of the following discussion points:

- How can Memorial best contribute to Newfoundland and Labrador's economic ecosystem?
- What characteristics of an IP regime (Policies / Procedures) encourage a culture of innovation?
- What supports exists or should be enhanced?
- What barriers are limiting successful innovation or knowledge transfer?
- What options exist for technology and market assessment, either in-house or through an external agency?
- How will Memorial know it has succeeded in innovation and commercialization?

3.0 Mandate and Role of the University

The primary outcomes of the University's core business activities are the graduates of its bachelor, master and doctoral degree programs, and the IP/knowledge generated through its research programs. University research programs are different from research activities in industry or in research organizations by the integration of university students in research activities with increasing intensity in bachelor, master and doctoral programs. Along with gaining specialized knowledge on specific subjects, research, especially when conducted in collaboration with industry, enables students in bachelor, master and doctoral programs to advance their understanding of the strategies, techniques and methods necessary to solve increasingly difficult, real-world problems. Additionally, when such problems are successfully resolved, the research outcomes can include valuable IP.

Research Grants and Contracts: Funds from research grants and contracts are primarily intended to support graduate student stipends, and to cover the costs of equipment, consumables, research assistant salaries, or travel for conferences and the dissemination of research outcomes. When a research program includes significant graduate student participation, the University typically makes an in-kind contribution of the faculty members' time as research activities are integral to the primary education mandate of the University for which the institution receives the vast majority of its operating funds (i.e., from a combination of grants from the Government of Newfoundland and Labrador and tuition fees paid by students).

Success in research grant applications is highly dependent upon a faculty member's reputation, primarily derived from traditional academic outputs, such as publication in prestigious journals or other forms of dissemination appropriate to his/her discipline. A faculty member's reputation and adequately funded research programs are key components to establishing the reputation of the institution and to attracting high-caliber graduate students. The researcher's reputation is also essential for attracting industry sponsors. The sponsor's interest, however, may also be tied to a research specialty related to a particular problem, and to the ability of the researcher to manage the project and deliver the outcomes in a manner that is consistent with industry performance norms.

Dissemination of Research Outcomes: It is expected that research outcomes be disseminated in a timely manner and although the method of dissemination may vary, for example by publication or patent, the Natural Sciences and Engineering Research Council of Canada (NSERC) sets the following expectation [2]:

"Every effort must be made to deliver the maximum benefit to Canada, which is defined as incremental Canadian economic activity and improved quality of life in Canada. In general, the industrial expansion or economic activity should occur within Canada… There should be a requirement to diligently develop and exploit the IP within an appropriate timeframe."

Universities and Economic Impact: Universities can fulfil their core mandate and create a positive economic impact. The provision of highly trained individuals with the knowledge and skills that are current and relevant for industry satisfies a fundamental human resource requirement. Collaborative research programs provide opportunities to align research activities with a sponsor's needs and also assist in finding specific solutions that assist the sponsor. In addition, the IP that is developed in universities can, in some cases, lead directly to new business opportunities.

As universities examine their role in facilitating technology transfer they must balance the needs of the institution with their core mandate and the realities of the environment in which they operate. For example, universities can structure their technology transfer function and associated policies to optimize service to faculty members, maximize royalties or stimulate economic development, or any combination thereof [3]. To optimize service to faculty, an institution may attempt to patent all disclosures and exploit royalties for each. To maximize royalties, a university may choose to exploit those discoveries with excellent market potential and do so with royalty terms that favour both creator(s) and institution. In order to stimulate economic diversification, a university may wish to maximize the number of transactions and accept modest licensing terms or reduce the up-front burden on fledgling spin-off companies by considering alternate strategies such as an equity share.

4.0 Feedback from Consultations

Memorial's external stakeholders clearly indicated that the institution is highly regarded and carries significant stature within the Province. Memorial's ability to attract investment for equipment and facilities was regularly highlighted as a strength, as was the capability of its people. With its multiple campuses (Grenfell, Marine Institute, and St. John's Campus) along with the Harris Centre and the Labrador Institute, Memorial touches many aspects of life in the Province. The Faculty of Engineering, the Marine Institute and the Harris Centre were highlighted as particularly active participants within the community.

Intellectual Property Policy: Memorial's Intellectual Property (IP) policy was identified as a barrier to developing collaborative relationships with industry partners. Both internal and external stakeholders suggested that Memorial should revise its strategy for managing IP. As well, many participants suggested that the University could exercise greater flexibility when negotiating IP rights. The special case of graduate student internships was highlighted by local firms who indicate that a requirement for IP rights to remain with the student is challenging and hampers the degree to which a student can be engaged. Additionally, Memorial has several policies governing IP, and some misalignment within

policies is impacting the relationship between faculty members and graduate students, particularly on larger or long-term research programs. During consultations, there was a repeated call for Memorial to consider evolving to a "creator-owned" policy model, and it has been suggested by some participants that institutions with IP policies that assign ownership to the "creator" are generally more innovative, and friendly to the private sector. The University's intellectual property policy is a fundamental element of an innovation strategy and therefore requires close examination.

Project Management of Research Projects: External stakeholders also report that there is an opportunity for Memorial to enhance its ability to manage deliverables on industry-sponsored research programs. To ensure good return on investment, industry partners require that project deliverables be effectively managed. The latter also report that project success is tightly coupled to the project management capability of the individual Principal Investigator (PI). Several stakeholders suggested that developing core competencies in project management and implementing a suitable project management structure would improve opportunities for collaborations with industry. It was suggested that streamlining internal university business processes and simplifying contract terms may improve timelines for negotiations and help create an environment that aligns with commercial expectations.

Marine Environments: It is clearly evident that Newfoundland and Labrador is unrivaled in its capacity to support developments in harsh marine environments. The ocean technology sector is vibrant and has established its international reputation as a leader. There is substantial capability supporting this sector, with research programs, dedicated institutions, local technology firms, oil and gas developments, fisheries and aquaculture, funding programs and all levels of government. Active research programs at Memorial in the Faculties of Engineering and Applied Science, Human Kinetics and Recreation, and Science are evident. Training programs and research activity at the Marine Institute and the Ocean Science Centre also provide direct support to this sector. To recognize this significant potential, an ocean technology cluster, OceansAdvance, was created in 2005. This cluster includes industry, academia, research and government, and works to promote economic diversification of the ocean technology sector.

Oil and Gas Industry Research Opportunities: With the development of its oil and gas industry, the Province's economy has experienced strong growth. Additionally, the requirement for the province's offshore operators to share revenues through investment in research and development has created excellent funding opportunities for Memorial's researchers. These funding opportunities have contributed to collaborative relationships and have allowed Memorial to expand research programs. Unfortunately, funding programs derived from oil and gas revenues tend to favour a select number of research interests. The Faculty of Engineering and Applied Science, the Department of Earth Science and the Marine Institute have been well-positioned to benefit from these programs, but opportunities for most other academic units have been - and continue to be - limited as research interests are not well aligned with the opportunities available from local industry. Even so, some sponsors would like to see greater participation in their programs.

Genesis Centre and Genesis Research: The Genesis Group Inc., a Separately Incorporated Entity (SIE) wholly owned by Memorial University, grew out of the Seabright Corporation which was initially established in the in the 1980s. In 1997, the Genesis Centre was formed and acted as an incubator on Memorial's main campus. The Genesis Centre has an established reputation and brand, and is an important partner for Memorial in the implementation of this strategy. The Genesis Group also operated the Genesis Research division which, until 2014, provided Industrial Liaison/Technology Transfer functions for Memorial, and managed the patenting and licensing of IP created at Memorial.

Local companies must compete to gain entry into the Genesis Centre and once accepted as a client, will receive access to services and resources aimed at creating high growth, knowledge-based enterprises. The Genesis Group is supported by a large number of local business leaders. These individuals sit on the Board of Directors, participate on the Selection Board, act as a Mentor, or sit on a Client Advisory Board. Successful operation of the incubator requires a significant commitment from the business community. Some long -term participants with the Genesis Group believe that the number of new entrepreneurs is declining. Additionally, some clients of the Genesis Centre expressed a desire to see more networking opportunities within the University community. During the consultations, several participants questioned the ability of Genesis Research to effectively identify the commercial potential of discoveries and to maintain the confidence of faculty.

External Partnerships: The participation of faculty members in collaborative research programs with industry and other organizations has consistently been reported as an essential element for success in innovation and commercialization. To achieve this, participation in industry-sponsored research programs must be attractive for the researchers while contributing to the progression of their academic careers. Successful collaborative research programs should create incentives and not detract from normal academic expectations. It is believed that creating an environment that encourages and rewards participation in collaborative research and development projects with industry and outside organizations will attract others with similar aspirations.

However, it can be difficult for industry partners, especially smaller local firms, to engage Memorial. There are many points of contact when working with the University. With multiple faculties, campuses and faculty members, the interface can vary. Additionally, when faculty members are seeking sponsors, they may do so independently, and it is possible for an industry partner to receive multiple independent proposals. The manner in which policies are applied may also influence how Memorial is viewed by potential sponsors. Specifically, the application of policies that influence the presentation of project costs, the management of deliverables, and the rights associated with IP, directly affect the sponsor's experience. A mechanism to ensure that policies are effectively implemented, well understood, and consistently applied is essential to building and sustaining a productive relationship with industry partners and sponsors.

When asked how Memorial should gauge success in establishing itself as an innovative institution, participants reported a variety of potential indicators including: the number of collaborative programs established and maintained; the number of partners participating in repeat research programs; the number of new entrepreneurs participating in the local economy; the number of students trained under collaborative programs working for sponsors after graduation; client service standards; the ability to attract strong faculty and graduate students; the growth in research funding; the number of new start-up companies; the number of industrial research chairs; the number of patents and licenses; and royalties from licensing of IP. Growth in collaborative research programs was reported most frequently as a success indicator, while generation of royalties from licensing appeared to be a secondary consideration. It should be noted that external stakeholders consistently echoed a message that the community expects Memorial to be an enabler of economic diversification and that there is an opportunity for Memorial to assume a greater leadership role in this regard within the Province.

Economic Ecosystem: Newfoundland and Labrador's demographics and location pose significant challenges. With a relatively small population, domestic markets are limited, and access to national and international markets is challenged by geographic location. Participants in the consultation sessions indicated that sustained economic advancements and diversification require the development of

products and services that can satisfy international markets. In addition, innovative universities are typically located in regions with close proximity to "anchor companies" that create opportunities for spin-off enterprises and act as receptors for IP [4]. The Province's lack of both anchor companies and IP receptors also poses challenges for its economic ecosystem. The consultations indicated that the local community looks to Memorial, the Province's only university, to play a lead role in filling this void.

5.0 Ownership and Management of Intellectual Property

Ownership of IP rights is determined through a variety of intersecting legal sources, including legislation, case law, contracts, collective agreements and policies. Ownership is often established by these sources with reference to the circumstances under which the IP in issue was created. By way of example, the law provides that copyright in a work created by an employee in the course of her or his employment is initially owned by the employer, while an employee will retain ownership of the patent rights in his or her inventions. Such general rules are subject to modification by employment and collective agreements and employer policies. It is important to recognize that creator, owner and author have distinct legal meanings. It is also important to differentiate between ownership of IP and rights to use IP.

University IP Ownership Models: In a university setting, ownership of IP rights normally falls into one of the following three categories: institution-owned, creator-owned, or jointly-owned. These models guide the assignment of ownership rights within the university, but do not define the relationship with third parties. In evaluating the impact of technology transfer on innovation and commercialization, the relationship with external partners must also be given careful consideration.

Memorial IP Ownership Model: At Memorial, IP ownership is determined pursuant to the Intellectual Property Policy and applicable collective agreements. At present, IP developed by employees in the course of their assigned duties and responsibilities is the property of Memorial, with several exceptions. Members of the Memorial University of Newfoundland Faculty Association ("MUNFA") and other employees who participate in research projects under the auspices of Memorial, with certain exceptions, have joint ownership with Memorial in all inventions, discoveries or creations conceived or developed during the course of research at Memorial. IP developed by a student in the course of his or her academic program is owned by that student, with some exceptions, notably that IP in a potentially patentable invention, discovery or creation that is conceived or developed by a student IP in the course of a research project under the auspices of Memorial is jointly owned by the student and Memorial. This recognizes Memorial's significant material contribution to the generation of IP within the university environment. Copyright in a work produced or created by a MUNFA member, another employee who participates in research projects under the auspices of Memorial or a student is vested in the author. For the purpose of this Innovation Strategy, Memorial is therefore regarded as jointly owning inventions with its researchers while copyright is creator owned. The vast majority of scholarly work at Memorial, which is not associated with external research contracts, follows the path of dissemination through publication at the discretion of the creator.

Joint Ownership of IP: Within the university context, many parties have a vested interest in the concept of joint IP rights, including faculty members, students (graduate and undergraduate), staff, and research collaborators. When the sponsor intellectually contributes to the IP, the sponsor would also have a reasonable expectation for joint ownership rights.

Issues surrounding the ownership and management of IP are complex. Universities carry out research to educate highly qualified people and to disseminate knowledge for the betterment of society. Traditionally this was accomplished through publication. In some instances, to maximize the impact of the research or to realize commercial value, there is a need to protect IP and restrict early disclosure. There is a risk that if an appropriate balance is not maintained between rapid disclosure and rapid protection, an overly protective environment may result and the academic benefits of open interactions may be curtailed. This balance is required to promote innovation.

IP of Commercial Potential and Background IP: Complexities develop when a discovery may have commercial potential, or when an industry partner wishes to place restrictions on IP arising from a sponsored research program. The complexity is compounded when both researcher and sponsor provide background IP. Generally, the University has an obligation to protect the graduate student's ability to complete his/her degree program, which includes a thesis exam and defence, and to ensure that researchers (i.e., faculty members, students or both, according to context) can advance their careers by disseminating their research results and maintaining a continued right to use the research result for further research. The industry partner reasonably expects to have its confidential information protected and to derive value from its investment by way of access to, or ownership of, the IP. It should be noted that the University's interest in IP is generally limited to that which is created by its researchers and usually excludes IP that is provided by an industry partner. The exceptions would be limited to occasions where IP may be derived from that of an industry partner or where Memorial wishes to secure licensing rights.

Benefiting from IP: The sponsor, researchers (e.g., faculty members, students, staff, etc.), and university can benefit from IP created under a sponsored research project in many ways. In an academic setting, publication of research results establishes the reputation of the researchers and acceptance of work by prestigious journals further advances their reputation. The researchers and the University benefit from the continued academic use of the IP in future teaching and research activities. Success in grant competitions is closely related to the reputation of the researcher and a university's ability to recruit top academics is also influenced by its reputation. There are also instances where IP can generate returns such as royalties or equity for the creators, for example, through copyright of literary or artistic work and computer programs, licensing agreements from patents or partial ownership in a spin-off company. In the simplest sense an individual's knowledge can also create value by improving employment potential or creating consulting opportunities. For the sponsor, IP created through the sponsored research project can help to create a competitive advantage through unique product features or service qualities that surpass others in the marketplace. A company's strategy for managing IP will include a variety of measures including patent protection, trade secret, trademark, data security and retention of key employees.

Tri-Agency Expectations on IP Management: In Canada, the Tri-Agency is a significant funder of university-based research and Tri-Agency policies and guidelines set expectations and influence standard practices within universities. The Tri-Agency is comprised of the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Social Sciences and Humanities Research Council of Canada (SSHRC). NSERC's policy on IP [2] can help to establish a benchmark and several key excerpts follow:

> *"NSERC's Policy on Intellectual Property (IP) promotes the use or exploitation of knowledge to build a strong national economy and improve the quality of life of Canadians."*

"NSERC's Policy on IP is based on the following principles:

1. *Encourage the utilization of research results, developed wholly or in part using NSERC funds, in Canada for the benefit of Canadians.*
2. *Promote the development of fruitful and productive partnerships and recognize the unique contribution each partner brings to the partnership and the need for each partner to benefit from the relationship and have their interests protected.*
3. *Support the publication of research results in the open literature. NSERC does not support secret or classified research.*
4. *Ensure that a student's graduation is not impeded by IP issues.*
5. *Support a researcher's right to use his/her research results for non-commercial purposes in future research and in teaching.*

"In order to ensure that the mandate of NSERC and the rights of all participants are protected, it is mandatory that all IP agreements, arising from and related to an NSERC award, contain clauses that address the following elements:

1. *Timeliness of exploitation: Agreements where access to IP is granted via an exclusive license or assignment, before the start of the project, must state that exploitation will be pursued with due diligence and within an appropriate time frame. These exploitation terms are dependent on the technology and the nature of the relationship between the parties, but must be included and allow for future use of the IP by the inventors in the case of a failure to exploit the IP.*
2. *Confidential Information: The IP assets of all participants must be respected. A partner's proprietary data, commercially sensitive information and potentially valuable results or ideas must be protected from unauthorized, inadvertent or untimely disclosure.*
3. *Research results cannot be secret: The results of the research must be publishable in the open literature. NSERC does not support secret or classified research. In order to secure IP protection, a maximum delay of six months is permitted when submitting papers for publication. No publication should expose a partner's proprietary information without their express permission to do so.*
4. *Academic progression: There can be no delay for the defence of a student's thesis.*
5. *Rights for future research and teaching: The university/college and its researchers must retain the right to use the knowledge or IP generated for non-commercial purposes in future research and in teaching."*

Recognizing that much fundamental research may be at an early stage and not sufficiently developed to allow IP protection, the Tri-Agency maintains policies that ensure confidentiality of grant applications during the review process. It also sets guidelines to ensure that review committee members avoid potential conflicts. This is a particularly important feature of Tri-Agency processes since applications for funding require the disclosure of the research methodology and techniques which may represent valuable IP in their own right. In the context of proposals submitted to companies/organizations other than the Tri-Agency, it is important to ensure that the proposals will be treated in confidence so as to protect the future commercial value of the IP. In the absence of confidentiality, a funding application could represent a public disclosure negating future patent protection or future commercialization opportunities.

Finally, the Tri-Agency acknowledges that technology transfer and commercialization activities naturally follow successful research outcomes, and through its Indirect Cost Program, enable universities to commit resources to the support of commercialization processes [5].

5.1 University IP Ownership Models

As previously mentioned, ownership rights within a university typically fall into three categories, creator-owned, institution-owned or jointly-owned. Consultations implied that Memorial's current IP policy, which is a jointly-owned model, is negatively impacting collaborative relationships. Some participants suggested that creator-owned policies are friendlier to research sponsors that wish to commercialize the research results and therefore encourage innovation.

Tantiyaswasdikul examined the implementation of IP policies at Canadian universities and concluded that [6]:

> *"Canadian universities with institutional IP ownership policy tends to produce more number of new licenses and patents while Canadian universities with inventor IP ownership policy can generate greater number of spin-off companies".*

Tantiyaswasdikul also notes that:

> *"However, regardless of the type of IP ownership; the productive commercialization is only possible when the inventors are actively involved and motivated in the process of technology transfer."*

In a report completed by the Impact Group entitled "Design and Positioning of an Innovation, Entrepreneurship and Technology Commercialization Centre – International Comparators Interim report, April 2014"[7], six internationally recognized postsecondary institutions were identified as leaders in innovation and entrepreneurship and selected as comparators. The comparator institutions are: Massachusetts Institute of Technology, Imperial College London, Technion – Israel Institute of Technology, Nan Yang Technical University, University of Michigan, and Aalto University. Of these institutions, 4 have an institution-owned policy and for the remaining 2, the institution retains ownership of IP when it is developed under a contract or collaborative agreement.

The Conference Board of Canada's 2012 report entitled "Who Dimmed the Lights? Canada's Declining Global Competitiveness Ranking" [1] ranks Canada's global competitiveness as 14th among developed nations. From this report, the top 5 most competitive countries are Switzerland, Singapore, Finland, Sweden, and the Netherlands. Data available at the time of this review indicates that all but Sweden have institution-owned IP policies.

The Intellectual Property policy at Waterloo [8] is considered by many to be the most progressive in Canada. The Waterloo policy is creator-owned with some clearly defined exceptions as follows:

"A. Principles
Ownership
Except as stipulated below, it is University policy that ownership of rights in IP created in the course of teaching and research activities belong to the creator(s).
The exceptions are:

- *The University normally retains ownership of IP rights in works created as 'assigned tasks' in the course of administrative activities ...*
- *Owners of IP rights in scholarly works created in the course of teaching and research activities grant the University a non-exclusive, free, irrevocable license to copy and/or use such works in other teaching and research activities, but excluding licensing and distribution to persons or organizations outside the University community. Any such licensing and/or distribution activity would be authorized only by an additional license from the owner(s).*
- *In sponsored or contract research activities, ownership of IP rights may be determined in whole or in part by the regulations of the sponsor or the terms of the contract. Participants in these research activities must be made aware of any such stipulations of the contract by the Principal Investigator, that is, the leader of the research project."*

*"**Rights to a Patent:** The University acknowledges that it has no direct equity in the ownership of any patent developed by a member of the University … except for: any requirements imposed by contractual obligations arising from any agreement to which the inventor(s) is (are) a party or participant, or, in the case of assigned tasks, where ownership rests with the University"*

Canadian universities with creator-owned policies continue to maintain oversight. Although Waterloo's policy [8] assigns IP rights to the creator(s), it includes the following provisions:

"Where researchers at the University enter into an agreement which waives, limits or assigns IP rights, that agreement must be reviewed and approved by the Vice-President, University Research or delegate and, if graduate students are parties to the research, the Associate Provost, Graduate Studies, or delegate."

"In situations where companies or agencies that fund research retain ownership of IP generated by that research, some other academic benefit must be derived… Whether any agreement for sponsored research will result in academic benefit to the researcher(s) and the University will be decided by the Vice-President, University Research or delegate in consultation with the appropriate Faculty Dean and department Chair."

Regardless of the ownership model, IP policies from Canada's U15 universities share the following common features:

- Academic obligations and the requirement to disseminate knowledge shall take precedence over commercial outcomes;
- If research agreements limit publication or ownership rights, there is an expectation of some other offsetting consideration which favours the researchers and the University;
- Graduate student involvement on sponsored research programs requires appropriate due diligence so that their academic programs are not negatively impacted;

- Support for the faculty member is required when commercializing;
- There is a fiduciary responsibility to share revenues between the creator(s) and the institution - this responsibility exists regardless of who leads commercialization efforts, creator or institution;
- There must be full disclosure and transparency by faculty members with respect to independent, outside activity, and a requirement to ensure such activity is conducted in a manner that does not create a conflict of interest or conflict of commitment;
- If IP is assigned to the faculty member, the Institution retains a perpetual, royalty-free license to use the IP for academic purposes;
- The inventor should receive a reasonable share of net revenue from royalties; and
- Sponsored research agreements between the University and research sponsor will vary the IP ownership rights of the researchers.

Canadian universities with creator-owned policies offer an opportunity for the faculty member to pursue commercialization without using university-based services. While creator-owned policies imply greater input from the creator in determining the desired disposition of the IP, in the context of the treatment of IP in sponsored research agreements at Memorial, the practice has been to only enter into sponsored research agreements where the varying of IP rights from Memorial's policy is with the consent of the researchers.

Based on a review of the literature and a thorough survey of Canadian IP policies, it is inconclusive which IP ownership model best facilitates innovation. What is clear however is that, for successful innovation outcomes to arise, faculty members must be engaged and motivated to participate in the process of knowledge transfer. The widely-held view from local stakeholders and the expectation within our university community is that a creator-owned model would contribute to a more dynamic innovation environment at Memorial.

5.2 Impact of Intellectual Property Rights on Technology Transfer

"Technology transfer is the process of transferring discoveries and innovations resulting from university research to the commercial sector…" [9].The commercialization of IP requires the participation of an industry partner. The partner can be a large multinational, an SME, a start-up, or a spin-off company.

Major Funding Programs and IP Rights: The trend in Canada, as seen through major funding programs, has been to allow greater flexibility in the transfer of IP from universities to industrial sponsors. For example, the NSERC Engage program requires that IP reside with the sponsor, and the NSERC Collaborative Research and Development program encourages flexibility in IP ownership rights. Such flexibility is balanced, however, with retained rights by the University to use IP for normal teaching and research purposes, rights to publish the research results, and a reversion of the assigned IP in the event that a partner fails to commercialize the IP. This trend supports the philosophy that commercial entities possess the industry networks and market knowledge required for successful commercialization. The Atlantic Canada Opportunities Agency (ACOA) and the Research and Development Corporation (RDC) of Newfoundland and Labrador also adhere to this philosophy.

Industry-sponsored Research and IP Rights: In the case of industry-sponsored research, the following examples describe situations where project IP rights may significantly influence the impact of a research program:

- Research programs that are aimed at developing standards require the support and involvement of many industry partners. In this situation, the faculty member would normally wish to retain ownership rights in project IP. When the researchers retain ownership, outcomes are disseminated through publication and conference presentations, and the whole sector benefits.
- Research that is aimed at developing compounds to help treat illness will only benefit society if it is accepted by a pharmaceutical manufacturer. To justify investment, the pharmaceutical company will require that the researcher has adequately protected the project IP.
- Research programs aimed at improving an existing industrial process or assisting in a product development may have only one industry partner who has significant interest in the research outcomes. The partner may provide existing IP to the program. If rights to use background IP are not secured, the sponsor may not be able to utilize the project IP. Additionally, if the research outcomes are accepted and implemented in a product development, the sponsor wishes to secure rights in the project IP that allows for continued developments.

Many strategies facilitate the dissemination or transfer of IP for the benefit of society at large. Likewise, appropriate strategies for managing IP rights vary. From the examples above, the influence of IP rights on maximizing the impact of a particular research program is highly dependent upon the nature of the research, previous investment by all parties and its potential beneficiaries. A policy that governs IP rights should permit flexibility in the context of sponsored research agreements between the University and a sponsor.

Public Financing and the Creation of IP: Research programs and the associated creation of IP are financed through a variety of channels. Faculty members often try to secure basic research grants from federal funding agencies and in Canada, the most fundamental, are those from the Tri-Agency. These programs fund a number of incremental “direct costs” of undertaking the research (i.e., stipends to students, cost of minor equipment, cost of materials, supplies and travel), and contribute at rate of ~28% to the “indirect costs” of the research (i.e., heat, light and other pre- and post-award administrative costs). These programs require the University to contribute the faculty member’s time to the research project. Since the education of highly qualified personnel (i.e., research students) and the public dissemination of knowledge are the primary desired outcomes of the Tri-Agency funding programs, it is reasonable for the University to contribute the faculty time toward this shared education/advancement of knowledge objective. Faculty member salaries and basic infrastructure (buildings, laboratory space, computing networks and libraries) are normally funded through the general operating budget of the institution, which, at Memorial, is comprised of grants from the Government of Newfoundland and Labrador and from tuition fees paid by students.

There are many other national and international sources of revenue to support research, including government departments and agencies, non-profit or charitable organizations, and the private sector and industry. Each funding source may have a distinct set of criteria.

A well-developed research program normally benefits from a variety of funding sources, and these revenues may support dedicated technical and administrative staff, equipment purchases, laboratory expenses, consumables and graduate student stipends. In time, the investment in a given program, and the developed IP, becomes substantial. If a research outcome is such that IP protection through

patenting is desired, additional fixed costs arise. Similarly, if an industry partner or sponsor contributes IP to a research program, this IP may have required substantial investment by the partner and could potentially represent significant value and risk. Also, collaborations between universities and industry can provide leveraging opportunities which are mutually beneficial. Finally, valuable IP may be created with varying degree of contributions from public or private sources, and the university's policies and procedures must take into account the complexity of public funds potentially contributing to the generation of private wealth.

IP Ownership Model and Business Processes: The effect of the IP ownership model on business processes must also be considered. In situations where it is desirable to alter IP rights, for example a research contract with an industry partner, the ownership model may influence the process. For contract negotiation, the cleanest model is one where IP rights reside with the institution and any contractual agreement involving IP is between the industry partner and the University. In a "creator-owned" model, several options exist. To facilitate an agreement, the rights must either be assigned to the institution or there may be parallel agreements, one between the sponsor and the faculty member (and institution, where appropriate) to address IP considerations and one between the sponsor and the institution to address all other contractual terms. At Memorial, most IP is "jointly owned" between the University and the researcher(s) and collaborative agreements currently require assignment of rights from the researchers to the institution.

Memorial IP Ownership: Memorial has an established IP policy [10] and it is supported by several procedural documents. There are provisions for IP in the collective agreement with MUNFA as well as guidelines from the School of Graduate Studies. In addition, the Marine Institute has established practices for IP management. Currently there is some misalignment between these documents. Effective implementation of an IP management structure requires clearly articulated objectives and alignment between all governing policies and procedures.

Memorial, as a publically funded institution has the responsibility to exercise appropriate stewardship in the use of its resources. As well, faculty members have professional duties and responsibilities that include teaching, research and academic service. To fulfil their mandate, it is appropriate that faculty members have reasonable autonomy and that their research be self-directed. As the University and its members become increasingly engaged with other industry partners, the potential to transfer IP for commercial exploitation grows. IP may also be commercially exploited through the formation of spin-off companies and Memorial's researchers may be active participants in these spin-off companies. This is a positive outcome but association of Memorial researchers with a spin-off company, particularly if there is potential for ongoing research collaboration, may impact eligibility in future grant competitions and impact the relationship between the University and the company with respect to license or contract negotiations. These relationships must be managed in a manner that is both supportive of researchers and is transparent with respect to Memorial's role as a publically funded institution and with respect to the researchers who are involved in the spin-offs meeting their obligations to the University.

Realizing Commercial Potential: It is generally observed that universities are not well structured to develop the commercial potential of discoveries. It is also generally accepted that technology development is only one component of a successful venture. Industry partners are therefore required to help develop and maximize the economic value, and the conditions under which a particular technology is transferred can significantly impact the commercial success. There are a variety of options to facilitate successful technology transfer. IP can be licensed exclusively, non-exclusively, or by geographic region or by sector of application. It is also reasonable for some benefit to accrue to the creators and to the

University in respect to a commercial success associated with IP originating from university-based research. The University, reflecting the expectations of its major Federal research funding partner, requires that the IP created in the course of university-based research be available for future academic and research use within the University.

As seen above, there are many paths to commercialization and many ways in which value can be realized for a product or service. Additionally, the risk profile for the partners may vary with the technology or market sector, and the value may be associated with market readiness and the ability of the creator to offer ongoing technical support. A willingness to be flexible, provided the University's core mandate is maintained, will help optimize potential impact.

6.0 A Culture of Innovation

A successful innovation strategy must take a holistic approach to ensure that a culture of innovation becomes embedded in the fabric of the institution. Memorial is well positioned to influence the economic ecosystem of Newfoundland and Labrador and consultations, especially with external stakeholders, indicated that Memorial has an obligation to help facilitate a positive economic impact. Through its multiple campuses and faculties, and broad base of alumni, Memorial touches all parts of the Province and clearly has a special obligation to the people of Newfoundland and Labrador. Consultations also indicated that the community has high expectations of Memorial as pointed out by Emke and Best [11]:

> *"Being the only university in the province raises the bar of responsibility".*

6.1 Memorial's Internal Environment

The Conference Board of Canada in its 2014 review of the Massachusetts Institute of Technology (MIT) innovation ecosystem [4] suggests that cross-pollination should be encouraged, and that an innovative culture can be taught, grown and cultivated. In this report, it was observed that:

> *"Four strategic elements within MIT support the innovation ecosystem: intrapreneurship and entrepreneurship; courses and educational experiences; connections to the research engine; and collocated spaces. Each element relies upon two principles for its success – (1) that learning should be engaged and active and (2) that innovators should be collocated, "rubbing elbows" whenever possible."*

Hall et. al. [12] in "Opportunities and Strategies for Advancing Innovation in Newfoundland and Labrador" also highlighted the opportunity to improve curriculum to better educate and develop entrepreneurs, and repeated the observations that innovation can be taught:

> *"MUN should offer training and develop courses related to innovation for all degree programs and consider postgraduate diplomas/masters programs in innovation"*

These examples articulate the opportunity for Memorial to play a greater role in the economic ecosystem of Newfoundland and Labrador, and indicate that there are tangible actions that Memorial can take to improve entrepreneurship within the Province.

There are many examples of how universities embed innovation into their programming. For example, Rensselaer Polytechnic Institute places master's students from the Lally School of Management and Technology with campus researchers to identify commercialization pathways for laboratory discoveries [13]. Also, co-operative education, internships and experiential learning programs inherently build links with industry partners, government agencies and not-for-profit organizations, and therefore contribute to a culture of innovation. Memorial currently has a variety of nationally-recognized programs.

Memorial's multiple faculties and campuses provide excellent opportunities for developing cross-pollinating opportunities through collaboration and curriculum development. For example, a recent initiative by the Faculty of Engineering and Applied Science in partnership with the Faculty of Business Administration to establish the Centre for Innovation, Entrepreneurship and Commercialization (CIETC) is an excellent example of academic units being proactive in developing a culture of innovation. As this initiative unfolds, the involvement of other Memorial faculties and campuses could fill innovation gaps. For example, "Currently 70% of total university transferred technology comes from life sciences..." [9].

The concept of "sandboxes" also speaks to creating common areas or multiuse labs that allow interactions between individuals from various disciplines. Creating a positive environment where good people have access to good facilities and the freedom to explore will enhance innovation.

Some members of Memorial's social sciences and humanities community have expressed an interest in initiatives that would support innovation related to tourism and cultural development. It should be noted that tourism development forms part of the Province's Innovation Strategy [14], and a recent proposal to consolidate Memorial's archives, if successful, will provide greater access for its researchers and potential collaborators.

Similar diversity forms part of the innovation culture at other universities. For example, Alto University in Finland has established four "factories" to facilitate collaboration, and one of the factories "the Alto Media Factory" is located in the School of Art, Design & Architecture [7].

Also, an editorial by Freedman [15], entitled "Canada needs new paradigm for research and innovation", suggests that Canada should:

> "Create a research strategy to commercialize [its] vast service potential, in everything from computer games to business intelligence products. We desperately need a commercialization strategy for publically funded research in university social sciences, humanities, art and design."

All of this suggests that, to maximize its impact, Memorial needs to encourage cross-disciplinary interactions and innovation-based curriculum development for all faculties and campuses.

6.2 Memorial and the External Environment

The primary drivers in a commercial setting are fundamentally different than those in a university research environment. However, it must be recognized that there is great potential for win-win collaborations and these should be nurtured. There have been several situations at Memorial where personnel from an industry partner are collocated with the research teams and this is proving to create very positive outcomes.

Collocation: Collocation provides immediate insight into discoveries and helps to build long-term, trusting relationships between Memorial's researchers, and external research partners and sponsors. Recent examples include the American Bureau of Shipping (ABS) Harsh Environment Technology Centre (HETC) which led to a major AIF-funded research project (STePSS) and a further Shell-ABS supported project to develop commercial modelling/simulation software for use in ship design. Additionally, Memorial has enjoyed a number of years of very successful research collaboration and technology transfer with Virtual Marine Technology, a spin-off company from research in the Faculty of Engineering and Applied Science. Both of these examples highlight the benefits of collocating university researchers and research collaborators from outside of the University. Relationships of this nature help increase receptor capacity and facilitate technology transfer. Consultations suggested that improved collaborations with industry is an important indicator of success and collocating industry partners with research teams will support this goal.

Requisites for Success in Collaborative Research: Motivated faculty with the willingness to engage industry partners on collaborative research programs is an essential element to advancing innovation. Such engagement, however, must be accompanied by a) the desire on the part of faculty members to drive innovation, b) an understanding by faculty members of the expectations associated with innovation, and c) willingness by faculty members to carry out the research within a disciplined project management framework. This project management framework also needs to respect processes related to confidentiality, timely disclosure of research results and activities in support of commercialization not normally associated with curiosity-based, grant-funded research.

When engaged in collaborative research with industry partners, it should be recognized that the expectations of the industry partners include different outcomes than those normally associated with fundamental, curiosity-based research. Some faculty members thrive in an environment where their research programs align with the interests of an industry partner while others have established their academic reputation on fundamental research. For those who chose to build research programs with industry partners, achieving success requires that their work can demonstrate value for the partner and typically, the partner wishes to support research programs that can address current challenges. Faculty members engaged in collaborative research programs with industry partners should be prepared to accept the additional constraints posed by these programs. Although collaborative research with industry partners may provide an alternate source of funding, it must not be pursued as a replacement for a traditional grant unless the more stringent expectations can be managed.

However, participation in collaborative research or entrepreneurial activities must also enhance academic career progression. This may be challenging in some disciplines as innovation-oriented research will have different outcomes than publication-oriented research. With the appropriate framework and demonstrated success, the university will improve its ability to recruit faculty members with an interest in innovation and help nurture an interest among existing faculty members. Policies will

also need to be clear and transparent so that faculty members can benefit from their participation with confidence that the fundamental obligations of teaching, research and service are not compromised.

Stakeholder Expectations: Memorial currently has a significant challenge in meeting the expectations of its many stakeholders. It is expected to promote economic diversification, provide incentives for its faculty members and create value for its external research partners. It is believed that increasing the quantity of successful collaborations with industry partners will generally improve overall performance and, when compared to other Canadian universities, there are opportunities for Memorial to experience meaningful improvements.

One such opportunity for improvement is related to the frequency of invention disclosures by faculty members and the research dollars required to facilitate each disclosure. Freedman analysed the inventiveness of Canadian universities and the results are presented in a report entitled "Which are Canada's Most Inventive Universities?"[16]. This analysis was based on 2010 data and used invention disclosures as a measure of inventiveness. The most inventive institutions produce approximately 0.1 invention disclosures per faculty member per year. When compared to research funding, the top universities required approximately $1.75 million per disclosure. On average Canadian universities produced 0.048 disclosures per faculty member. Data for Memorial suggested 0.013 annual disclosures per faculty member and each disclosure required $6.21 million in research funding. Disclosures alone do not necessarily result in patents, licenses or spin-offs but are a fundamental starting point for defining the number of successful transactions.

There is a significant opportunity for Memorial to position itself as one of the most progressive and innovative environments in Canada. If Memorial aspires to be among the most innovative, the foregoing data suggests that its strategy should encourage actions that create early stimulus.

7.0 Streamlined Business Processes Related to Innovation

Response times can significantly impact the success of technology transfer, especially when a market window may have a finite life. The principle of "first to market" significantly influences value and timeliness is an essential element in ensuring that a commercial entity can maximize market potential. While efficient negotiation processes are required to help improve success rates, both the University and industry partners need to expedite internal processes for negotiation and approval of contracts. The need for Memorial to streamline its innovation business processes and improve customer service has been previously highlighted [17]. Additionally, recent consultations suggest that streamlining business processes and simplifying contract terms may improve timelines for negotiations and help create an environment that aligns with commercial expectations. As a result, ongoing efforts to improve internal service delivery in this regard should continue.

In regard to policies that impact the interaction with industry partners, consistency of application will improve confidence and help maintain long-term relationships. In particular, policies on intellectual property and indirect costs must be coherent, transparent, clearly communicated and applied consistently. Since discussions with industry partners often start with faculty members as the points of contact for Memorial, it is critical that faculty members who wish to engage in research activities with industry partners be familiar with policies related to matters such as intellectual property, contract

administration and indirect costs and ensure that their early discussions with industry partners are consistent with such institutional policies. Furthermore, it is critical that faculty members engage appropriate offices of the University prior to engaging in any discussion or negotiation of contract terms and conditions, including the cost to the industry partners for the research or terms associated with access to intellectual property.

8.0 Research Project Management

There is a need for Memorial to enhance its ability to manage deliverables and intellectual property associated with industry-sponsored research programs. To ensure good return on investment, industry partners require that project deliverables and intellectual property be effectively managed. More particularly, industry partners frequently report that project success is tightly coupled to the project management capabilities of the individual Principal Investigator (PI) and the individuals employed within a project to carry out project management functions. Several stakeholders suggested that Memorial should develop core competencies in project management and implement a suitable institution-wide project management framework that would facilitate more effective collaboration with industry.

The Current Situation: At Memorial, there are a variety of approaches for managing research projects. Generally, a faculty member is the lead or principal investigator who assumes overall responsibility for project management, and for the deliverables. The faculty member may also be obliged, by the terms of a research agreement or University policy, to disclose discoveries and cooperate with commercialization activities. There is administrative support available within the faculties, and, if required (due to the complexity or scale of the project), dedicated staff can be hired. For some larger projects, centralized services are available through the Major Research Partnerships (MRP) unit which is currently with the Office of Research Grants and Contracts Services. Projects administered through MRP retain a dedicated project manager, and projects are managed centrally, with ultimate accountability to the Vice-President (Research). More service-oriented research and development projects in the Faculty of Engineering and Applied Science are managed through the Industrial Outreach Group (IOG) which holds a permit to practice from the Professional Engineers and Geoscientists of Newfoundland and Labrador and which has a standard, Memorial-approved contract for any projects carried out through the IOG. At the Marine Institute, applied research projects are managed through their specialized centres and typically projects retain a technical lead and project manager.

Much of the existing support for research projects is based on the administrative and project deliverable requirements of a traditional grant. In this structure, the faculty member's primary responsibility is ensuring the success of his/her graduate students and publishing research outcomes. Often, sponsored research agreements with industry partners have more stringent requirements and place significant contractual obligations on the University. Deliverables are clearly defined with expected outcomes, timelines and costs. In addition, obligations can include data security, prompt invention disclosures, background IP disclosure, review periods for any associated publications, and confidential examinations of associated theses.

A full understanding of such obligations by researchers is critical to the successful management of projects, and appropriate skills and supports are also necessary to facilitate effective project management.

Enhancing Current Structures and Processes: In a recent review of MRP's project management function, Belanger [18] suggests that the development of a university-wide project management framework, with common tools, would enhance consistency and provide greater support for the Principal Investigator (PI) in managing research projects within the PI's own faculty or school. A discussion paper by Bazan [19] recommends the creation of a standard Project Management Office. Such a Research Project Management Office (RPMO) would provide support to PIs for project definition, estimating, planning, monitoring, controlling and reporting of innovation deliverables, while actual project management and delivery would reside within the faculty or school under the PI's direct supervision, with full accountability to the dean.

Memorial should consider evolving the research project management function, currently offered through MRP, to a Research Project Management Office (RPMO) as described above. The RPMO should reflect the value of the project management profession and develop core competencies as well as common tools, methodologies and templates that can be generally available for all faculties and campuses. Additionally, the RPMO would retain a small complement of certified project managers who would be available to support projects when requested by the PI or administrative unit (i.e., faculty, school, campus). PIs engaged in collaborative research projects would be encouraged to use services of the RPMO. Additionally, the RPMO would be expected to function as a client service unit and establish key performance indicators to demonstrate added value. The RPMO should be innovation-driven and its responsibilities should include:

- Assisting with project proposals and scope definition along with identifying existing and differential resources;
- Developing detailed project plans including key milestones and deliverables;
- Identifying IP provisions such as confidentiality, data security and anticipated disclosures;
- Facilitating ongoing dialogue with Innovation Office to help maximize innovation outcomes and encourage timely disclosures and appropriate IP protection strategies; and
- Monitoring, controlling and reporting project status.

9.0 Industrial Liaison and Technology Transfer

Historically, the Industrial Liaison Officer (ILO) and Technology Transfer Officer (TTO) functions were carried out on behalf of the Vice-President (Research) by a separately incorporated entity, the Genesis Group Inc., through its Genesis Research Division. Until August 2014, the Genesis Research Division acted as Memorial's agent for patenting and licensing of IP. It also fulfilled Memorial's obligations to the Springboard Atlantic partnership related to industrial liaison and technology transfer across universities in Atlantic Canada (i.e., in return for funding support). Because of the increasing range of innovation-oriented research projects at Memorial, it was decided to bring the industrial liaison and technology transfer functions back into the University under the direction of the Vice-President (Research) where there could be better integration of these functions with Memorial's research activities.

The structure of an office (i.e., an Innovation Office) to support industrial liaison and technology transfer at Memorial will follow from the recommendation of the present report. The consultations highlighted the fact that the University needs to provide a range of integrated services to promote technology transfer and to ensure effective management of its IP, such as:

- Assessing markets to identify potential delivery options, users and value of discoveries;
- Assessing innovations/inventions to validate claims and determine uniqueness and novelty;
- Selecting an appropriate IP protection strategy;
- Developing specific commercialization strategies for specific instances (i.e., license, sale, spin-off company) as an early step in the development of a research proposal;
- Ensuring collaborative agreements provide appropriate consideration when IP is a factor;
- Managing information related to patents, licenses, available technologies and other related records; and
- Offering training and information sessions related to IP protection and commercialization.

The delivery of these services requires highly competent, experienced individuals with specific knowledge of patenting processes and commercialization strategies, along with excellent market insight, extensive professional networks and a clear view of research activities. Given the breadth of research programs and of potential receptors, retaining subject matter experts for all disciplines and industry sectors is not practical and Memorial will need to establish appropriate partnerships with other institutions, service providers and industry partners. As well, confidence of faculty members will be enhanced if a proactive approach to identifying and promoting innovations is consistently applied.

An Innovation Office would operate at the interface between Memorial's research community and its industry partners. The effectiveness of this organization would have an immediate impact on the success of commercialization initiatives and on the institution's reputation. Given the many competing interests, clearly defined goals and objectives are paramount.

10.0 The Way Forward

Given the current dynamic economic environment of Newfoundland and Labrador, Memorial has the opportunity to become one of the most progressive and innovative universities in Canada. This will require significant effort for growing collaborative relationships with industry and to support technology transfers to local firms or spin-off companies. Exercising flexibility and demonstrating modest expectations will help increase the quantity of successful initiatives. To support these objectives, the University needs to:

- Foster a culture of innovation,
- Revise and implement its policies in support of innovation,
- Establish responsive business structures and processes, and
- Ensure adequate oversight and guidance of its innovative structures and processes.

Memorial can increase its contributions to economic diversification within the Province. Continued cooperation from Government, industry and the community will assist in maximizing the potential benefit. If Memorial truly aspires to find itself among the most innovative, actions to create early stimulus should be encouraged.

10.1 Recommendation 1 - Foster a Culture of Innovation

Context

There is an opportunity for Memorial to establish a culture of innovation and to imbed it within the fabric of the institution. The whole university community should be engaged and ideally, a culture of innovation should be apparent in the various faculties and campuses.

The project led by the Faculty of Engineering and Applied Science and the Faculty of Business Administration to establish the Centre for Innovation, Entrepreneurship and Commercialization (CIETC) is an excellent example of academic units being proactive in developing a culture of innovation. Joint faculty chairs, undergraduate curriculum, support for co-op programs, mentors and a student leadership team will help to create the next generation of entrepreneurs. Furthermore, similar initiatives should be considered for other faculties.

Collocation is fundamental for creating an environment that fosters innovation. Personnel from industry sponsors should be provided an opportunity to share spaces with research teams as this will enhance technology transfer and aid in the creation of long term, win-win relationships. In addition, receptor capacity may be improved if Memorial attracts international organizations to work within its research community. Shared spaces for students should also be considered, as a positive environment where students of varying disciplines, have access to good facilities and the freedom to explore will enhance innovation.

Programs such as Industrial Outreach in the Faculty of Engineering and Applied Science provide an opportunity for businesses to accesses its unique facilities and CREAIT offers access to its specialized scientific instruments through a fee for service structure. To simplify the interface with the University, a similar approach should be considered for other faculties.

A series of awards and recognition programs will help to demonstrate that innovation is valued and supported. Awards for students may create incentives for new graduates and help to highlight entrepreneurship as a career option. Additionally, faculty members must be motivated and willing to participate in initiatives that support innovation, technology transfer and commercialization. Participation in these activities should enhance the progression of an academic career.

Individuals interested in pursuing commercialization opportunities will require access to resources that aid in facilitating the process. Memorial should develop process documents, training materials and seminars to guide decision making. Topics should include IP protection, commercialization pathways, market assessment and technology readiness. These resources should be made available to faculty members, graduate students and others who may wish to participate.

Actions:

As a result, the following specific actions are recommended for fostering a culture of innovation:

- Provide resources that aid in facilitating the commercialization process. This shall include skilled advisors, process documents, training materials and seminars. These resources should be made available to faculty members, graduate students and all other interested employees.
- Recognize faculty member contributions towards innovation and commercialization so that participation in these activities enhances an academic career.
- Create a series of awards and recognition programs to demonstrate that innovation is valued and supported. Awards for students should highlight contributions to innovation, including entrepreneurship as a career option and the transfer of intellectual property to industry.
- Develop undergraduate and graduate curriculum to introduce students to innovation.
- Encourage collocation of personnel from industrial sponsors with research teams to help enhance technology transfer and create receptor capacity.
- Provide shared spaces with common tools and mentorship to encourage entrepreneurial students, of varying disciplines, to explore and innovate.
- Support innovation within the community by providing a mechanism for local businesses to access Memorial's infrastructure and resources.

Champions

Provost, Vice-President (Administration and Finance), Vice-President (Research), Vice-President (Grenfell), Vice-President (Marine Institute), Deans of Schools and Faculties

10.2 Recommendation 2 - Revise and Implement Policies to Support Innovation

Context

Policies related to intellectual property are fundamental in promoting innovation. Memorial's IP policy is described in several documents, including: a general policy entitled "Intellectual Property", the collective agreement with MUNFA, guidelines from the School of Graduate Studies and established practices at the Marine Institute. Some misalignment currently exists between these documents. Also, IP rights of students, especially graduate students involved in large or long-term research programs require greater clarification. All documents that define the IP policy framework should be aligned and inclusive of all members of the University and supportive of Memorial's vision and core mandate.

Motivated, engaged faculty are essential for the advancement of innovation. It is believed that creator-owned IP policies would further encourage faculty participation in commercialization activities. As a result, Memorial should consider a creator-owned model for IP that respects the following principles:

- Academic obligations and the requirement to disseminate knowledge should be preserved regardless of commercial outcomes to be achieved from the research;
- If research agreements limit publication rights or alter IP ownership rights, there should be some other offsetting consideration which favours the researchers and the University;

- Graduate student involvement on sponsored research programs requires appropriate due diligence so that their academic programs are not negatively impacted;
- Support for the researchers is required when commercializing;
- There is a fiduciary responsibility to share revenues between the creator(s) and the institution - this responsibility exists regardless of who leads commercialization efforts, creator or institution;
- There must be full disclosure and transparency by researchers with respect to independent, outside activity, and a requirement to ensure such activity is conducted in a manner that does not create a conflict of interest or conflict of commitment;
- If IP is assigned to the researcher, the Institution retains perpetual, royalty free license to use IP for academic purposes;
- The inventor should receive a reasonable share of net revenue from royalties;
- The University's share of net royalties should be reasonably distributed between 1) the Vice-President (Research), 2) the academic unit (faculty, school or campus), and 3) the department (if applicable);
- There should be a mechanism to determine the sharing of ownership of IP arising from projects involving multiple researchers and for which there is joint-IP; and
- Sponsored research agreements between the University and research sponsor may vary the IP ownership rights of the researchers.

Technology transfer through the formation of spin-off companies represents a positive outcome but the association of Memorial researchers with a spin-off company, particularly if there is potential for ongoing research collaboration, may impact eligibility in future grant competitions and affect the relationship between the University and the company with respect to license or contract negotiations. These relationships must be managed in a manner that is both supportive of researchers and is transparent with respect to Memorial's role as a publically funded institution and with respect to the researchers who are involved in the spin-offs meeting their obligations to the University.

Memorial must carefully examine contractual terms associated with collaborative agreements, and exercise flexibility when economic development and technology transfer can be enhanced. Industry sponsors should have a variety of options for accessing IP including licensing (exclusive, non-exclusively, or by region) or assignment. Contractual terms should give consideration to the core mandate of the University, total investment by all parties, interests of the beneficiaries, subsequent academic benefit and guidance of the creator(s). The University should also include consideration for, market readiness, requirement for ongoing technical support and the potential impact on economic diversification, particularly for Newfoundland and Labrador based SME's and spin-off companies.

To develop sustainable productive relationships with industry, Memorial should establish mechanisms to ensure that policies are effectively implemented, well understood, and consistently applied.

Actions

In summary, the following innovation-related initiatives are recommended related to policy, conflict of interest, contracts and procedures:

- Consider evolving to a creator-owned model for IP
- Review and revise all Memorial University policies related to intellectual property to establish alignment between all supporting documents;
- Ensure clearly articulated and transparent conflict of interest and conflict of commitment policies and procedures so that faculty can participate in commercialization activities with confidence that the fundamental obligations of teaching, research and service are maintained. The University should develop a framework that ensures relationships of this nature are supported and effectively managed;
- Carefully examine contractual terms associated with collaborative agreements and exercising flexibility when economic development and technology transfer can be enhanced; and
- Establish mechanisms to ensure that policies are effectively implemented, well understood, and consistently applied.

Champions

Vice-President (Research), Faculty Relations, Vice-President (Administration and Finance)

10.3 Recommendation 3 - Establish Responsive Business Structures and Processes

Context

Efficient business processes and a supportive organizational structure are required to ensure that industry sponsors recognize value and can consistently engage the University. The institution should create appropriate structures to support all aspects of the process from initial stages of project proposal development through to the implementation of a commercialization strategy. A focus on client service must be evident at all stages of the process.

Project management competencies are essential in building confidence with industry sponsors. Memorial should consider establishing a Research Project Management Office (RPMO) and common tools. Where necessary, principal investigators could receive training on tools and methodologies. The RPMO would be expected to function as a client service unit and establish key performance indicators to demonstrate added value.

The technology transfer / industry liaison function should be re-established through an Innovation Office with a compliment of experienced professionals. Its Director should have an appropriate reporting relationship within the Office of the Vice-President (Research) and the Innovation Office should be responsible for:

- Assessing markets to identify potential delivery options, users and value of discoveries;
- Assessing innovations/inventions to validate claims and determine uniqueness and novelty;
- Evaluating sector-specific innovation strategies;
- Selecting an appropriate IP protection strategy;
- Developing specific commercialization strategies for specific instances (i.e., license, sale, spin-off company) as an early step in the development of a research proposal;
- Ensuring collaborative agreements include appropriate language related to IP;
- Managing information related to patents, licenses, available technologies and other related records; and
- Offering training and information sessions related to IP protection and commercialization.

Delivery of these services requires highly competent, experienced individuals with knowledge of the patenting process and commercialization strategies along with excellent market insight, extensive professional networks and a clear view of research activities. Thorough analysis of commercialization strategies will require the assistance of professionals from external organizations as well as partnerships with other universities. Additionally, adequate funding for this organization will reduce the reliance on immediate revenue generation to offset operating costs. In return, longer term strategic goals aimed at increasing economic diversification may be pursued.

Actions

The following actions are intended to help establish responsive business structures and processes:

- Assign responsibility for innovation to an Associate Vice-President;
- Establish an Innovation Office, define responsibilities, develop supporting resources recruit professional staff;
- Establishing a Research Project Management Office (RPMO); and
- Continue business process improvements to gain enhanced client service.

Champions:

Vice-President (Research), Vice-President (Administration and Finance)

10.4 Recommendation 4 - Provide Adequate Oversight and Guidance

Implementation and ongoing oversight of this strategy should be guided by an advisory committee. This committee should be comprised of representatives of Memorial's research and academic communities, the Government of Newfoundland and Labrador, funding agencies, Genesis, the Ocean Technology Cluster, the oil and gas industry, and other Provincial technology-based industries. Its initial function shall be to guide the development of a detailed action plan and then oversee its implementation.

It is also expected that the advisory committee will monitor ongoing performance and recommend revisions to this strategy as necessary. The committee should also establish key performance indicators based on the following measures of success [20]:

- Quantity and dollar value of research partnerships and research chairs;
- Ratio of sponsored research to the university's operating revenue;
- Ratio of the number of spin-off businesses, business revenue, and jobs resulting from University outcomes, to the number of graduates;
- Quantity of invention disclosures, patents and licenses to the number of faculty members;
- Quantity and value of commissioned works of artistic creation; and
- Ratio of invention disclosure to revenue from research grants.

Actions

To provide continued guidance and oversight it is recommended that Memorial:

- Establish an Innovation Advisory Committee comprised of business leaders and Memorial's research and academic communities; and
- Establish and monitor key performance indicators.

Champions

Provost, Vice-President (Research), Vice-President (Grenfell), Vice-President (Marine Institute), Deans of Schools and Faculties

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Glossary of Terms

Industry Partner: A private sector company or commercial entity that has made a financial, in-kind or other meaningful contribution to a research project.

Intellectual Property (IP): All data, information, materials, concepts, know-how, formulae, inventions, improvements, industrial designs, processes, patterns, machines, manufactures, compositions of matter, compilations of information or data, technology, technical information, software, code of all types, layouts, interfaces, applications, tools, databases and database layouts, works (including without limitation all literary, artistic, pictorial, graphic, musical, dramatic and audio-visual works) and all compilations thereof, developments, trade secrets, integrated circuit topographies and integrated circuit topography products, plant varieties, domain names, prototypes, specifications and all other intellectual and industrial property, whether or not registrable or the subject of applications for registration.

Innovation: A process through which economic or social value is extracted from knowledge—through the creation, diffusion, and transformation of ideas—to produce new or improved products, services, or processes[21].

Principal Investigator: The researcher who leads a proposal submitted by the University for external funding and who agrees to undertaking the research in accordance with the terms of the Research Contract.

Researcher: Any individual who is involved in the intellectual direction, control and/or conduct of the research activity. This individual may be a faculty member (including sessional appointments), visiting scholar, adjunct, emeritus, honorary research professor, or executive in residence. The individual could also be a student in an undergraduate, graduate or postgraduate program, staff member, or a community or industrial partner.

Sponsor: Any funding agency, non-profit organization, private sector company or entity that makes a financial or in-kind contribution to a research project.

Appendix A: Recommended Implementation Plan

	Action	Champion	Completion Date
Foster a Culture of Innovation	Provide resources that aid in facilitating the commercialization process. This shall include skilled advisors, process documents, training materials and seminars. These resources should be made available to faculty members, graduate students and all other interested employees.	VP(R) VP(A&F)	Apr 2016
	Recognize faculty member contributions towards innovation and commercialization so that participation in these activities enhances an academic career.	VP(R) Provost VP(Grenfell VP(MI) Deans	Apr 2016
	Create a series of awards and recognition programs to demonstrate that innovation is valued and supported. Awards for students should highlight contributions to innovation, including entrepreneurship as a career option and the transfer of intellectual property to industry.	VP(R) Provost VP(Grenfell VP(MI) Deans	Dec 2015
	Develop undergraduate and graduate curriculum to introduce students to innovation.	Provost Deans	Dec 2015
	Encourage collocation of personnel from industrial sponsors with research teams to help enhance technology transfer and create receptor capacity.	VP(R)	Feb 2016
	Provide shared spaces with common tools and mentorship to encourage entrepreneurial students, of varying disciplines, to explore and innovate.	VP(A&F)	Sept 2016
	Support innovation within the community by providing a mechanism for local businesses to access Memorial's infrastructure and resources.	VP(R) Provost	Feb 2016

	Action	Champion	Completion Date
Revise and Implement Policies to Support Innovation	Consider evolving to a creator-owned model for IP.	VP(R) Provost	Nov 2016
	Review and revise all Memorial University policies related to intellectual property to establish alignment between all supporting documents.	VP(R) VP(A&F) Provost	Nov 2016
	Ensure clearly articulated and transparent conflict of interest and conflict of commitment policies and procedures so that faculty can participate in commercialization activities with confidence that the fundamental obligations of teaching, research and service are maintained. The University should develop a framework that ensures relationships of this nature are supported and effectively managed.	VP(R) VP(A&F) Provost	Feb 2016
	Carefully examine contractual terms associated with collaborative agreements and exercising flexibility when economic development and technology transfer can be enhanced.	VP(R) VP(A&F)	Oct 2015
	Establish mechanisms to ensure that policies are effectively implemented, well understood, and consistently applied.	VP(R) VP(A&F)	Apr 2016
Establish Responsive Business Structures and Processes	Assign responsibility for innovation to an Associate Vice-President.	VP(R)	June 2015
	Establish an Innovation Office, define responsibilities, develop supporting resources and recruit professional staff.	VP(R)	July 2015
	Establishing a Research Project Management Office (RPMO).	VP(R)	Oct 2015
	Continue business process improvements to gain enhanced client service.	VP(R)	June 2015
Oversight and Guidance	Establish an Innovation Advisory Committee comprised of business leaders and Memorial's research and academic communities.	VP(R)	June 2015
	Establish and monitor key performance indicators.	Committee	Oct 2015

Appendix B: List of Consulted Stakeholders

Organization Consulted	Session Date
Faculty of Arts	March 6, 2015 March 17, 2015
Faculty of Business	December 11, 2014
Faculty of Engineering	November 27, 2014 November 28, 2014 December 2, 2014 December 5, 2014 December 15, 2014 January 16, 2015
Faculty of Science	November 24, 2014 November 25, 2014 December 5, 2014 December 12, 2014 December 16, 2014 January 7, 2015 December 19, 2014
Faculty of Medicine	January 14, 2015 January 22, 2015 February 11, 2015
School of Pharmacy	December 17, 2014
Grenfell Campus	January 28, 2015
Labrador Institute	December 9, 2014
Marine Institute	December 11, 2014 January 30, 2015
Genesis Group	October 17, 2014 October 28, 2014
Genesis Board	December 8, 2014 December 16, 2014 December 18, 2014 December 19, 2014 December 22, 2014
Department of Natural Resources	November 25, 2014
Department of Business, Tourism, Culture and Rural Development	December 4, 2014
Department of Advanced Education and Skills	December 17, 2014
Department of Fisheries and Oceans	November 28, 2014
Petroleum Research Newfoundland and Labrador	November 5, 2014
Atlantic Canada Opportunities Agency	November 12, 2014

Organization Consulted	Session date
Research Development Corporation	November 20, 2014
Canada- Newfoundland and Labrador Offshore Petroleum Board	December 1, 2014
OceansAdvance	November 7, 2014 December9, 2014
Newfoundland and Labrador Environmental Industries Association	November 4, 2014
Newfoundland and Labrador Association of Technology Industries	November 4, 2014
Aerospace and Defence Industry Association of Newfoundland and Labrador	December 17, 2014
Heritage Council	March 4, 2015
St. John's Board of Trade	January 26, 2015 February 9, 2015
Husky Energy	November 5, 2014
Extreme Ocean	November 7, 2014
Nalcor	November 12, 2014
TEC Edmonton	November 13, 2014 November 20, 2014
Canatec	November 17, 2014
Nocland	November 19, 2014
Exxon Mobil	November 20, 2014
Springboard Atlantic	December 2, 2014
Deloitte	December 9, 2014
VMT	December 11, 2014
Fugro	December 22, 2014
Rutter	January 16, 2015
University of Manitoba	February 18, 2015