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## ABSTRACT

Developing effective, long-term relationships between business and industry and universities is essential to workforce and economic development. This paper details the range and class of activities, including the development of a "pipeline" for Information Technology students and a Letter of Intent cementing relationships, that have been ongoing between the University of Southern Maine's Information and Innovation unit and business and industry for the last three years. This is a concerted and systematic effort to increase student education for Maine's IT workforce through research, development, and commercialization that is ongoing and continues to develop in scope and depth.

### Keywords

Business, industry, relationships, student-pipeline, student-centered, Letter of Intent, coops, internships, workforce development

## CONTEXT AND PERSPECTIVE

The University of Southern Maine (USM), the state's only regional comprehensive university, is located in Portland Maine, the population and economic center of Maine. The 2010-2011 enrollment at USM is 9,634 students, 57% of whom are 18-24 years old. Companies such as UNUM, National Semiconductor, Wright Express, IDEXX, Quantrix, and others are located in Southern Maine. Each of these companies, if not an information technology company, per se, has a significant Information Technology (IT) workforce. UNUM, for example, employs approximately 1,100 IT workers.

Information and Innovation (I&I) is USM's research, development, and commercialization unit designed to engage students, faculty, and staff in IT initiatives from basic research through the development of applied technical solutions. Projects are intended to generate intellectual property and commercial products and services that add value to business and industry. I&I comprises faculty, staff, and students from Computer Science, Technology, and other disciplines as required. I&I's mission is clearly focused on workforce development of students. Undergraduate and graduate students are always included in all I&I projects, and each faculty member is an active advocate and mentor for students.

I&I is a unit of USM's Provost's Office and reports to the Associate Vice President for Research, Scholarship and Creative Activities. I&I is currently funded by Maine Economic Improvement Fund (MEIF) monies provided by Maine state legislation for the purpose of workforce and economic development. All MEIF supported activities at USM are designed to evolve from being dependent upon MEIF monies into self-sustaining units. I&I is supported by MEIF and external funding received by its Director, Project Coordinator, and four Principle Investigators (PIs). Additional selected faculty and staff are included in projects as specialized expertise is required for successful completion of deliverables. I&I currently supports thirty (30) students engaged in Research & Development & Commercialization (R&D&C) activities and mentored by its PIs. I&I has an Advisory Board of nine (9) members, leaders in the IT field and representative of business and industry (B&I) partners in the region.

There is a genuine need to fuel the IT workforce and economy of Maine. Since the "dot.com" bust in the late 1990's, enrollment in Computer Science (CS) at USM has been uneven at best; in the last few years the program has rebounded, but with about 100 undergraduate majors is less than half the enrollment of the early 1990's. The Department of Technology's applied Information and Communication concentration has remained stable at around 100 students for the last five years. However, the need for a baccalaureate level trained technical workforce has escalated significantly with the arrival of new companies and particularly due to the retirement of IT workers at larger technology intensive companies. According to the Maine Department of Labor, there were over 8000 IT workers in 2008. This means that these workers have a job description and or federal (O*NET) title that matches the IT designation for standard human resources categories. In Maine, most

businesses employ less than 25 full time workers and discovering jobs that pertain to IT only is extremely difficult, given that these small business expect employees to "wear whatever hat" is required on a given day for a given task, and many tasks in these small businesses are dependent upon IT skills.

Approximately 33% of the students at USM are "non-traditional", meaning that they are not in the 18-24 year age range. In Maine, there is a significant "first generation" college student population (USM, 2011). Many of these students' socio-economic standing and associated finances causes them to work more than one job while enrolled in classes or to have to "stop-out" for a semester or more at a time to earn monies to afford tuition.

Given the USM student profile and mapping it against the IT workforce needs yields two important facts; first, USM needs to recruit and retain more students and be prepared to provide them with financial assistance and second, students, particularly undergraduates, need to be engaged early-on in meaningful internships or coop experiences that lead to improved job prospects upon graduation. These factors and conditions are critical to student success and assurance of the economic sustainability and development of the IT and other technology dependent sectors in the region. Further, strategic alliances are required between business and industry and USM to guarantee the growth of the Maine workforce (Pellet, 1997).

USM graduates in CS or IT are financially and technically important contributors to the workforce and community. In the Portland area, the median household income is $35,650 and 36.4% of the population above the age of 25 have bachelor's degrees; this is almost 14% above the rest of the state, based on US Census figures of 2000 (new census data is being compiled) (United States Census Bureau, 2009). The current average beginning salary for bachelor degree graduates in CS is approximately $55,000, and the average beginning salary for bachelor degree graduates in IT is approximately $45,000. These salaries are significantly higher than average in Maine, even when time and inflation are factored into the effective wage differential.

Therefore, in order for students to achieve graduation consistently and within a reasonable period of time, students must remain enrolled in school, be engaged in meaningful projects, be paid, and have ready access to a "pipeline" for employment.

## DEVELOPING RELATIONSHIPS

Like many comprehensive regional universities, USM has been developing means for outreach to business and industry (B&I). I&I continues to work with the Chief Financial Officer's (CFO) office and with the Associate Vice President for Research Creative and Scholarly Activities and the Dean of the College of Health, Science, and Technology to develop a unified, viable, scalable collaborative model designed to stimulate workforce and economic development in IT. Three important elements have emerged: 1) comprehensive strengthening of the relationships between USM and B&I; 2) better communication and more frequent interchange; 3) the mutual creation of a vehicle, a Letter of Intent, which would define how the relationships and communications would benefit students and strengthen workforce and economic development. In the past, individual faculty members have consulted with B&I and been quite successful. However, there has not been a "boundary agent"-based (active liaison role) (Calder, 2007), unified, standardized approach to working with IT in B&I. Given the intent of the MEIF legislation, a structure that will increase the workforce and economic growth of Maine is an essential outcome for the Letter of Intent. As part of the Letter of Intent, there is provision for projects that are funded by B&I. These projects will both financially support students and provide operating monies for I&I. The Letter of Intent is the platform upon which the model for collaboration is being built (Moskowitz, and Kern, 2003).

## NEED FOR STUDENTS - A SKILLED TECHNICAL WORKFORCE

UNUM predicts that due to retirements, and transitions in products and business practices, that there will be five hundred (500) IT jobs opened over the next five (5) years. IDEXX is growing at a remarkable rate and adding computer science jobs both to their product research and development units as well as IT jobs to their infrastructure and overall IT workforce. In a current research project between the Maine Department of Labor and I&I, data is being collected about IT jobs and models are being developed for forecasting the needs for the state's IT workforce. Anecdotal information from I&I Advisory Board members, and B&I tour debriefings with local business and industry IT leaders indicates that there are far too few Computer Science/Information Technology graduates to meet the demands of business and industry in the region. In fact, some companies have had to open offices out of state to recruit skilled IT workers, and or resort to outsourcing IT services requirements.

## PIPELINE AND LETTER OF INTENT

The term "pipeline" is used frequently and is informed by its context in I&I Advisory Board Meetings and in the Letter of Intent. The Letter of Intent is a non-binding agreement between I&I and business and industry outlining mutual beneficial activities that will establish and support the pipeline. There is the "pipeline for employment" for the students, meaning that when students begin to work in I&I there is a path from their beginning level tasks and assignments to future employment. This path may begin by working with a faculty mentor on an existing or new project, or doing tasks that are needed for the preparation of a proposal or funded project. These first stage assignments are intended to familiarize the student with best

practices and the surroundings of the labs and resources as well as other students, staff, and faculty. In the second stage of the pipeline students are introduced to IT leaders and their staff, often through the B&I tours and presentations, in order to build and refine their skills in technical knowledge. The third stage may be a summer internship or coop, or a project that is shared between I&I and B&I. The final stage is that the student is offered a position at the business or industry.

**Method and Data**

The method of the study is a modified case-study approach consistent with naturalistic inquiry (Guba and Lincoln, 1982). Minutes from meetings with business and industry IT leaders and with university faculty, staff, and administrators and in-depth conversations over a period of three (3) years, provided the basis for this work. Naturalistic inquiry research relies on the "natural setting" (*in situ*), for the research; hence the business and industry tours, the meetings, both formal and informal, and three years of email among and between business and industry leaders in IT and I&I formed the body of data for this research. Given its methodological requirements, a list of frequently used terms and concepts was developed. Common terms and concepts in this research emerged as: "pipeline", "job fair", "coop", "internships", "students", "real world experience", "mentor", "expert practitioner", "student-centered", "jobs", "tours", "workforce development", and "collaborative projects". From these terms and concepts, the original version of the "contract" that was later refined into a "Letter of Intent" was created. The method for the Letter of Intent creation paralleled the method of the study. The goal of the Letter of Intent was to cement and formalize (in a friendly, non-binding manner) the relationship between business and industry IT leaders and USM's I&I. The research methodology was straightforward in that the terms and concepts used most frequently and in a context illustrative of "emphasis" became identified as important and enduring. These concepts became the language of the Letter of Intent as well as the critical components of the research. Because this research is longitudinal in nature, this paper contains only selected, but seminal aspects of the evolution of the student-centered relationship between B&I and I&I. The data is a "slice of the natural setting and interactions" between B&I and I&I, and analysis geared towards capturing this important period of history in the relationship, acknowledging that there is more data forthcoming and that such data will inevitably change or reinforce the view presented in this work.

**Background**

Information and Innovation and its predecessors at USM have been working with business and industry partners and collaborators for many years in an informal and episodic fashion. In a September of 2010 meeting of IT leaders, it was suggested that a contract, Letter of Intent, or a non-binding Letter of Intent be developed and implemented. The term "Letter of Intent" emerged as the best descriptor for what is required for most effective relationship building. This Letter of Intent's primary purpose is to formalize a business relationship between IT leaders in the region and I&I in order to organize and regularize a variety of activities and expectations that have grown organically over the last several years.

**Elements of the Letter of Intent**

This non-binding Letter of Intent is a "friendly document" generated by members of the Innovation and Innovation Advisory Board to show good faith arrangements for increasing workforce and economic development in the region. Important elements of the Letter of Intent include: 1) Student pipeline for internships and coops as well as permanent employment; 2) Annual IT Job Fair; 3) Collaborative Projects involving USM students, faculty, and staff and expert practitioners from B&I; and 4) IT presentations and tours by business and industry and USM, including presentations by recent hires from USM who are now working for B&I, as well as prospective hires, and current students, faculty, and staff at USM.

**Steps in Developing the Letter of Intent**

The architects of the Letter of Intent were leaders from UNUM, IDEXX, and Quantrix along with I&I leadership. When originally discussed, the idea was to devise a mechanism to formalize the productive arrangements between B&I and I&I. At first, a contract was suggested, but that was considered much too formal. Then the idea of a Letter of Intent (LOI) was suggested, and the LOI label persisted for several months, while the ideas were being developed and improved. Finally, and due to a need to ensure that the relationship would be free of legal bindings, the term "Letter of Intent" was found to be acceptable to all parties. From the outset, the Letter of Intent has been developed to be an open, evolving, non-binding, and shared document and the process for its creation and establishment has followed the same principles.

The Letter of Intent has been developed over a six (6) month period and has gone through successive approximations of refinement from the original "ledger" model, which was the original idea. The Letter of Intent was conceived of as a kind of balance sheet with one side of the ledger specifying what business and industry would contribute and would expect of I&I with the other side specifying what I&I would contribute and would expect from business and industry. As members of the I&I Advisory Board edited and shaped the document through four (4) rounds of revision, it has become more concise and consistent. A fifth round was undertaken by Quantrix leadership and I&I to add appropriate non-binding, but more precise language. This round was done in anticipation of submitting, for approval, the Letter of Intent to both University of Maine System Counsel and to appropriate management and offices at each business and industry collaborator.

**Intended Outcomes of the Letter of Intent**

There four (4) intended and immediate overarching outcomes from the Letter of Intent: 1) Establishing and accelerating relationships between B&I and I&I; 2) Exchanging of technical information; 3) Gaining practical experience for students; 4) Meeting the goals MEIF legislation for workforce development. Students gaining practical experience in a real-world job setting, where there are important and genuine deliverables, is an essential goal of the Letter of Intent. This goal is developed in two ways. First, students are hired as interns or coops and are assigned tasks and projects from within the company. The second is through collaborative project(s) staffed by students and faculty working with business and industry counterparts on a project that is proposed by business and industry. This second scenario is highly beneficial in that it allows the faculty and students to move from the classroom/lecture/lab directly into a project/lab setting that provides for immediate application of what has been learned in the academic environment. This arrangement is ideal and has potential for positive and timely curricular impact.

To date, several projects have been suggested, ranging from "technical requirements gathering" to "software development projects". The workforce and economic development goal from the MEIF legislation is a top priority for I&I. Along with more frequent and in depth exchange of technical information and formal and informal meetings, tours, and presentations, the Letter of Intent details the need and desire for an IT Job Fair, an Online Student Resume Book, a Web-Portal for communication between B&I and I&I, and the activation of a coordinated coop and internship program with requisite software.

**Ongoing Needs for Technical Talent (Curriculum Development)**

"University research and technology transfer to entrepreneurial companies is important and Increasing" (Shane, 2002). As companies grow there is an escalating need for CS and IT talent. From interviews and follow-up sessions addressing the value and success of the business and industry tours, it has become clear that the standard CS curriculum (ABET approved and accredited) and the Department of Technology (ATMAE approved and accredited) curriculum provides the core of knowledge required for software engineers, software developers, and systems administrators and engineers desired by business and industry.

A critical issue being discussed is how to make the curriculum agile enough to keep up with new demands and at the same time maintain the rigor and discipline of the core of courses required by ABET, ATMAE, and the faculty. The curriculum is now being informed by the I&I Advisory Board as well as the CS Advisory Board. Tuning the curriculum both in IT and CS is a complex process that must balance the concerns of highly principled foundational courses and new knowledge, tools, and systems that are actively being sought by the business and industry IT Leaders. It is clear from all B&I participants that students must possess strong fundamental computer science and technology skills and are now expected to possess and engage in efficient "customer-facing" interactions and effective communications skills. There is mutual support for and the firm understanding that students are at the center of interest for both B&I and I&I.

**Student Growth and the Need for Innovation**

For example, in the past students did not become acquainted with the value of intellectual property development and the culture surrounding inventions, innovation, and discovery of new knowledge until they graduated and been employed for many years. Students were generally unaware of contributions that are made in the discovery of new knowledge or its early application, and almost never cognizant of the processes, procedures, and protocols involved with creation and protection of intellectual property. Students need to become familiar with how business and industry plans for, encourages, and places value on intellectual property while working in Research & Development & Commercialization (R&D&C) settings. I&I students become acquainted with innovation, invention, and development cycles working in B&I settings such as the product development labs of IDEXX. Curricular models and offerings in Computer Science and Technology are informed by the interactions and information exchange between B&I and I&I. A recent example of this exchange is the expressed need by B&I for courses, or a curriculum, in data assurance and network security. Cyber Security is considered an important addition to USM's curriculum and promises to be popular with students. As B&I seeks more students trained in security technologies, and will be providing internships and coops, it is important that students are fully prepared to participate in these experiences, and are geared to thinking innovatively. The combination of internships and new curricular offerings in Cyber Security will help lead to permanent employment in what is considered a growing set of employment opportunities in the region, and certainly where innovation is required. In this case it means that B&I should expect that students will immediately contribute to their resources and assets, and over time become innovators and leaders.

**Elements of Relationships**

Over the last three years, the primary means for communication and engagement has centered on the I&I advisory board meetings and the business and industry tours. It is important to understand that "…collaboration between university and industry takes many paths. Some of these are official ones under the administration of universities, while others are informal,

conducted between researchers or laboratories and industrial firms." (Watanabe, 2009). Meetings have been informal, but regular in that there has been at least one business and industry tour per semester and at least one I&I Advisory Board meeting per semester with separate, informal debriefings and follow-up meetings after the tours and presentations. One tool that was recently developed is a "Who's Who in IT at USM", which began as a PowerPoint presentation and was migrated to the I&I website. This simple "roadmap" was extremely well-received by business and industry and is being continually refined and improved. The "boundary agent" liaison role was discussed by Calder (2003) as essential to building and maintaining best practices in building relationships between universities and business and industry. In agreed upon elements of the Letter of Intent, the need for a liaison or mutual liaisons was highly supported. This means that there is one person at each B&I collaboration site (company), and one person at USM (I&I) who is designated as the liaison. The role of the liaison evolves the kinds of activities proposed via the Letter of Intent or those that emerge from collaborative work. The Who's Who is the seminal document for establishing and perpetuating the communication channels. The content of the Who's Who is simple text and graphics that outline which departments, faculty members, and staff personnel are involved in CS and IT and a set of links and contact information that the B&I IT leaders can rely upon to help them find a course, a curriculum, or technical expertise. For many B&I IT leaders, attempting to thread their way through the complexities of a university structure is daunting and less than efficient.

## Projects and Deliverables

At a recent I&I Advisory Board meeting, an open request for proposals and projects was issued. In keeping with the elements of the Letter of Intent, there is mutual interest in having students, faculty, and staff from I&I to work with B&I on projects. "After all, technology transfer is frequently embodied in the transfer of human capital via graduate students, postdoctoral fellows, or a faculty member on leave or sabbatical from the university" (Siegel, 2003). From the outset, there is an understanding that students are at the center of interest for both B&I and I&I, for without the well managed, healthy "pipeline" of students, all parties will be diminished. In some cases, B&I has tactical or low-risk projects that are well-suited for students, or there is a "gap in expertise" in a more strategic project which may be addressed by students under the direction and mentorship of I&I faculty.

Projects such as "requirements gathering" or "software development" were proposed by B&I. I&I responded by "match-making" with faculty who are best qualified (and available) to meet with the IT leaders to develop a set of deliverables and project management guidelines, including timelines, numbers of students involved, and resource requirements. These relationships are valuable to students and faculty. "While collaborating with a firm on an R&D project, the university faculty member may serendipitously gain a valuable insight into a personal research area." (Lee, 2000). Students are selected for work in I&I and with B&I by their faculty mentors based on performance in courses and potential for success in their respective programs. Students are most often leaders in their classes or have exhibited extraordinary technical skills and aptitudes.

Scheduled meetings are critical to the success of the projects, and frequent, high quality communication is required in order for projects to benefit all parties. Projects bring IT expert practitioners from B&I in frequent contact with students and their faculty mentors. Exposure to expert practitioners from B&I provides USM students with an understanding of real-world problem solving in technical arenas that produces additional insights for the students who have often not encountered the kinds of complexity, timelines, and demands required to succeed in the marketplace. "Likewise, we would be required to express all in economic terms about the learning of practical knowledge relevant to teaching, the creation of internship opportunities for students, and the personal networks developed out of collaboration." (Lee, 2000). These collaborative projects bring together best practices from the academy, the laboratory environment, and the industrial competitive environment and accelerate the productivity and readiness of the students and contribute to the network of IT professionals in the field and set the foundation for further business and industry relationships as USM students become the next IT leaders in B&I.

## Next Steps

In addition to working with each other on industry proposed projects, I&I and B&I will be joining forces in seeking federal funding for increase the "length and scope" of the IT pipeline. The Letter of Intent states the pipeline is an important element in the relationship between B&I and I&I. It is clear that the beginning of the pipeline should not start at the freshman year. It should start in the K-12 schools. I&I and B&I have both created outreach programs on an individual basis. Plans are being developed to produce a program and seek federal dollars to determine how to best engage and stimulate the interest of K-12 students in IT in Maine. The relationship between I&I and B&I facilitates proposal writing and the implementation of after-school, summer programs, and special events that will be of interest to K-12 students and their parents.

## Evaluation

Timely and appropriate evaluation has been an ongoing expectation of the I&I Advisory Board since its inception. As mentioned earlier, after each of the business and industry tours and presentations there has been a debriefing and evaluation

session. These sessions have been instrumental in the growing success of the events. Evaluation has ranged from the general to the specific including setting the times and locations of the events, to developing questionnaires and comments from the students in advance of the events and providing them to the presenters. Fundamental to the Letter of Intent is the evaluation and metric-setting component. A subcommittee from the I&I Advisory Board will help to determine the metrics for success and will evaluate the direction and implementation of the Letter of Intent as well as provide guidance and direction to I&I in terms of its mission and goals.

**CONCLUSION**

This research presented a carefully described and documented "snapshot" or selected segment of the history of the emerging and evolving relationship between business and industry and the University of Southern Maine's Information and Innovation. By definition, this "story" and the associated research is incomplete, in that IT leaders are still signing the Letter of Intent and creating new collaborative projects. However, this work is extremely important in that frames the seminal activities surrounding the "first of kind" relationship at USM that is "student-centered" and promises to increase the IT workforce in Maine.

Universities and business and industry must work in concert for workforce and economic development. "Many companies, both large established and startups, want a closer, more involved relationship with academic scientists that they work with." (Etzkowitz, 1998). The interdependencies between the two are highlighted particularly well in the competitive global market. The work of the last three (3) years has been foundational in creating a solid working relationship between IT business and industry leaders and USM's Information and Innovation unit. Successes include but are not limited to the placement of CS and IT students in key positions in business and industry. UNUM employs more than twenty (20) USM graduates, and many of these are in key technical positions. This new and stronger relationship and the resulting Letter of Intent promises lucrative jobs for students who participate in internships, coops, and meaningful projects. Students' learning and real-world experience are central to the goals of the Letter of Intent. CS and IT students who work and learn in I&I benefit from the Letter of Intent as they are supported by funding from B&I and or from MEIF. These students earn while they learn. Students are fully engaged with faculty and experts from the IT field. The mutual development of the Letter of Intent is helping to strengthen relationships and agreements about workforce and economic development. B&I gains value by being actively engaged in the education and training of their future workforce. USM's students benefit from early engagement with B&I, which leads to gainful employment and success in their careers as contributors to technological innovation and leadership in Maine.

The coordinated and systematic efforts to develop and sustain research, development and commercialization relationships have resulted in regular business and industry tours and presentations, a systematic approach to arranging internships and coops, and standard procedures for collaborative projects. The Letter of Intent between USM and business and industry has been the key to these successes.

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