

**An Integrated Model of University Technology Commercialization and
Entrepreneurship Education**

**Arthur A. Boni, Ph. D. and S. Thomas Emerson, Ph. D.
Donald H. Jones Center for Entrepreneurship
Tepper School of Business
Carnegie Mellon University
Pittsburgh, PA 15213-3890**

January 2005

***Section One - Challenges of Commercializing Technologies and New Company
Formation in a University Setting***

The intellectual capital and property developed by our nation's universities are often heralded as a significant resource for the introduction of new and innovative products and services to the country's economy. Beginning in 1980 with the passage of the landmark Bayh - Dole Act, universities began in earnest to build their technology transfer activities to protect the university intellectual property, transfer it to industrial partners via licensing to existing companies, or to stimulate new business creation via start-up companies (another part of the Bayh-Dole legislation that stimulated the initiation of the Small Business Innovation Research – SBIR- program at the federal government level). The Association of University Technology Managers publishes annual reports that highlight the very significant impact that the nation's universities have had in both of these areas. Full information can be found at www.autm.net. In Pittsburgh, the base of sponsored research at Carnegie Mellon University, the University of Pittsburgh, and the UPMC Health System collectively exceeds \$750 million annually. Benchmarking from AUTM annual reports that provide benchmarks suggests that this base of research should produce approximately 8 to 10 companies annually, and that has been observed in the Pittsburgh region in the late 1990s and the first few years of the 21st century.

While AUTM statistics provide good benchmarks for the university-based start-up initiation process, it must be recognized that it is a necessary condition for a start-up company to execute on a potentially commercially viable opportunity includes the following essential components: development of the opportunity (identification of a compelling customer driven market need, development of a market strategy, articulation of a value proposition); acquisition of resources necessary to compete in the marketplace in light of competition; and development of a world class leadership team – in addition to executing a license with the university. While many of the technology-based spin-offs from universities are potentially viable, the lack of market-driven, entrepreneurial leaders

is often rate limiting. We postulate that the business school can effectively augment the university technology transfer office in developing and growing successful start-ups. MBA entrepreneurship programs often have potential leaders with some level of industry experience who can provide the appropriate market perspective to develop these opportunities as part of their MBA curriculum as described herein. Furthermore, alumni networks include entrepreneurs who are seeking “serial experiences”. In this paper we use Carnegie Mellon University as an example of this approach. The objective would be to accelerate both the pace and probability of success of university-based start-ups. We have found that suitable performance metrics do not exist for such a model, and this could become the subject of a future research study in entrepreneurship. The University of Washington is currently beginning such a study of management teams in start-up company teams (ref. Corey Phelps, University of Washington, private communication, 2004). Also Gary Cadenhead at the University of Texas has been tracking winners of their Moot Corp. competition (ref. “No Longer Moot – The Premier New Venture Competition from Idea to Impact”, Gary M. Cadenhead, Ph. D., 2002, Remoir).

Developing an effective and integrated model for university-based technology commercialization includes challenges and actions that must be taken at the university level (and this is a university-wide effort), within public institutions in the community, and within the business community as illustrated in Figure 1. We illustrate this model from our own institution and region, and suggest that those in other regions should extend the concept to the conditions applicable in their own universities and communities. Within the Carnegie Mellon University community we include faculty, students and administrators, along with the technology transfer office – officially named the Innovation Transfer Center; the business community (the extended network that includes the venture capital and angel investors, the entrepreneur service providers – incubators, law firms, accounting firms); and the public institutions (economic development organizations, technology councils) that support entrepreneurs in the community.

Within the university community, challenges include:

- Marketing input early – most often university faculty and student researchers focus principally on the technology and not the market. It is important to create an environment where solutions for real problems in the market are identified early, and innovative technologies can then be used to provide solutions for the market.
- Team Building – faculty and student researchers are often ill equipped to lead company spin offs, and conflict of interest and commitment are prevalent. Therefore the spin off is challenged with an inexperienced and incomplete management team.
- Delays and complexity of the licensing process. Faculty and their commercialization partners can be understandably frustrated by lengthy negotiations, time delays, and inflexible licensing terms.

Community-wide challenges include the existence and close linkages between the university and the community:

- Economic development groups supporting pre-seed investments to advance technology development, market development, and IP development appropriate for protection of products to be introduced into the marketplace.
- Receptive and active investor groups and networks (angels, early stage VCs, later stage VCs). Without adequate and “value-added” investors the fledgling venture often fails due to lack of adequate resources.
- The lack of an adequate pool of successful entrepreneurs in the community which makes the team building issue very difficult. This situation exacerbates the funding of early stage ventures and also leads to less than desirable success in the commercialization process.
- Incubators are neither a necessary nor sufficient condition for success or early stage companies. However in many cases the existence of an incubator to provide space, facilities and counseling to early stage companies does in fact stimulate successful transition from the start-up to emerging company stage. The incubator is another resource at a company stage where resources are often lacking or too expensive.

Section Two - Business School Entrepreneurship Center Complement to Technology Transfer Efforts

The role of the technology transfer office is to work with faculty to develop IP and licensing strategies. While there is an effort to commercialize technologies via start-up companies, most universities approach this via faculty and community efforts and the tech transfer office plays a supportive, but important role. There simply isn't enough time to promote company formation actively. Financial incentives associated with company formation are often less than for licensing to existing companies.

The role of the entrepreneurship education program is to educate and support entrepreneurs in the university environment and to build bridges to the outside community. Mature entrepreneurship centers such as the Donald H. Jones Center (DJC) for Entrepreneurship within the Tepper School of Business at Carnegie Mellon University are ideally suited to partner with the technology transfer office. As noted, technology transfer at Carnegie Mellon resides in the Innovation Transfer Center (ITC).

At the DJC, we have a multi-fold strategy consisting of:

1. Integrated curriculum development at the MBA, undergraduate, and community level that is focused on :
 - Opportunity recognition and strategic development.
 - Team building and leadership development.
 - Resource acquisition and allocation.
2. Launching and supporting entrepreneurial companies with well balanced and qualified teams of entrepreneurs.
3. Connecting entrepreneurs with value-added investors, support networks, and partners.
4. Ongoing monitoring and mentoring of spinout companies during their start-up and emerging growth stages.

Our teaching program provides the necessary skill sets for entrepreneurs and utilizes experiential learning to impact the ability of the entrepreneur to anticipate failure modes at all stages of the company life cycle. David Morgenthaler, founder of Morgenthaler Ventures provided us with some interesting statistics on over 200 companies in their investment portfolio (private communication). As illustrated in Figure 2, the failure modes are as follows. The first and least often encountered failure mode is technology – 10% of the failures; *i. e.*, the technology is not able to perform at the necessary level, not able transition from the laboratory into commercial practice accounts, or to be scaled up at all or not economically to commercial levels. Market factors account for 30% of the failures; *i. e.*, the market not developing, not being able to be competitive, or failure to access sales channels, etc. Standing out is that 60% of the failures result from the failure

of the leadership team to execute the business plan. While the Morgenthaler portfolio analysis represents just one data point, it certainly reflects our experience (we are in the process of gathering a broader range of data from contacts in our venture capital network). This will be the subject for another paper at a later date.

The constituency and audience includes students (graduate, undergraduate, researchers, and MBAs), the research faculty, and to a certain extent the administration that must be receptive to creating and maintaining an entrepreneurial culture and policies. Additionally, direct links to centers of excellence are developed in the university including schools, colleges, institutes, research centers, etc.

We have found it important to develop programs and interfaces to link our teaching faculty directly with the key internal constituencies. Examples include:

- Seminars and Lecture Series across the campus.
- Entrepreneurship courses in the business school and in each school or college.
- Business plan competitions – internal and intercollegiate.
- “ Boot camps”.

We also actively expose our students to visiting entrepreneurs (regional and beyond), venture capitalists, and lawyers (corporate and IP) very regularly.

Launching/supporting new ventures is supported by the capstone of our teaching program, which is a team-created business plan with validation by local, national, and international business plan competitions. These plans are also validated by outside entrepreneurs in our network. Our program at the Tepper School of Business is described in more detail in the next section.

Section Three – Overview of the Tepper School of Business Program via the Donald H. Jones Center for Entrepreneurship

Below, we describe three major initiatives focused on the University; all tied either directly or indirectly with the Innovation Transfer Center:

Program Overview - While Carnegie Mellon has realized numerous successes in the area of entrepreneurship education, much more can be done. In fact, in response to many student and faculty requests to access entrepreneurship education more directly and in a manner more targeted to their specific interests, the DJC launched a two-pronged initiative last year to bring entrepreneurship education to a much wider audience and to impact the success rate of technology commercialization, company formation and successful growth.

- Launched an MBA course in the fall of 2003 entitled Technology Commercialization Workshop, a one-semester course. The Workshop provides student participants with hands-on experience in initiating and developing a technology-based firm. Participants are 2nd year MBA students who work in New Business Teams (NBT), each assigned an early-stage invention and an experienced entrepreneur-mentor. The technologies are pre-screened for commercial potential by the course professor who develops a portfolio from the Innovation Transfer Center and from local companies, inventors, universities, and economic development organizations that fund early stage technology development. Each team identifies and quantifies potential markets for the technology, assesses capital requirements, and develops a commercialization strategy and business plan required to advance to an initial funding round.

This course links our MBA students with technologists on campus and in the community to commercialize technology. During the academic year 2003-2004, NASDAQ provided a seed grant that has enabled development of curricula and facilitated the seed funding of select innovative projects. Following graduation in June 2004, three technology-based companies were launched from this program. They are: 1) EA Devices, Inc. (the EA Needle, energy assisted biopsy device for lung and breast cancer diagnostics); 2) Clear Count Medical Solutions, Inc. (RFID-enabled operating room management of sponges and instruments); and 3) Biostics, Inc. (acoustic MEMS system for drug discovery and diagnostics of biological molecules for a variety of applications). Both EA Devices and ClearCount have received seed funding to initiate operations and commercialization, and Biostics is currently seeking funding. We describe these activities more fully in Section 4 as recent case studies.

In the current academic year we have 14 MBA student teams working on commercialization strategies and plans for technologies from the School of Computer Science, Mellon College of Science, Carnegie Institute of Technology (the school of engineering), and from local companies. We have plans to extend the technology sourcing to other non-profit institutions and commercial organizations both regionally and nationally.

- Created an approach to bring the undergraduate and non-MBA entrepreneurship curriculum directly to the other six colleges and schools at Carnegie Mellon at the undergraduate and graduate levels. We piloted this program via a single course: Technology-Based Entrepreneurship, in 2003-2004. The program was highly successful and well received. We collaborated with faculty and deans from other schools on campus and this single course has been multiplied to three courses, tailored specifically for 1) engineering students, 2) computer science students, and 3) biology and other science students. These courses are now offered in their respective schools (as opposed to in the DJC) and bear the names Introduction to Entrepreneurship for CIT (which is CMU's engineering school), Introduction to Entrepreneurship for Computer Scientists, and Introduction to Entrepreneurship for Mellon College of Science.

The courses described above work in a complementary fashion with our curriculum as a much broader entrepreneurship curricula. **The purpose of the program described above is to reach out from the business school and to stimulate innovation and commercialization at Carnegie Mellon and to form teams of MBA and undergraduate business students with engineers and scientists.** We plan to augment team formation and to engage our broader network as such (see below).

Each team in these academic programs developed business plans, and we organize and host internal business plan competitions on campus both at the undergraduate and graduate levels. These internal competitions provide students valuable experience in the stages of business planning and commercialization, and serve as “feeders” for participation in external competitions as described below. Teaching entrepreneurship “where the inventors and innovators are located” also drives the tech transfer pipeline with commercially viable ideas and opportunities that have been matched with market need prior to ITC direct involvement, *i. e.*, we are attempting to provide a market perspective (market pull) rather than the technology push approach to technology innovation.

- Venture Competitions – business plan competitions with real world entrepreneurs and investors as judges.

As noted above, it is necessary for emerging entrepreneurs and their companies to develop business plans that can be used to attract adequate resources to commercialize their technologies and to create successful organizations. Resources include financial and business partners as well as funding for management teams. The business plan competition has become a common venue for refining and developing business plans and communication skills of teams and providing them with the opportunity of getting feedback and advice from potential investors (venture capitalists and angels) and entrepreneurs who have built successful companies.

We have found it useful to look at this process as a three-fold, time - sequenced evolution:

(1) Internal competitions at Carnegie Mellon (at both undergrad and MBA level) to select the best of our annual portfolio of opportunities. (2) Intercollegiate competitions held nationally “to raise the bar” on the level of competition and to gain a national perspective from entrepreneurs and investors. (3) The McGinnis Venture Competition, our own international intercollegiate MBA competition to provide both an international perspective and level of competition which can showcase our program and provide opportunities for a broader range of our constituents (students, faculty, and administrators) to see the venture creation process first hand and to interact with international teams. We also bring in qualified judges from outside of our region so local investment opportunities can become more visible on a national level, and investments from outside of the region can be facilitated. The judges include successful entrepreneurs, venture capitalists and angel investors.

We also have developed and are building on two major initiatives focused outside the university. These are developed to provide access to networks of entrepreneurs, investors, technologies, service providers, and partners for our emerging companies.

- Alumni-driven hubs in technology centers in the United States. Our initial focus is in Boston and Silicon Valley, where CMU has a large base of alumni who wish to remain engaged with and provide support to the university. These regions have a large concentration of successful entrepreneurs and investors and clusters of companies that may be partners for emerging companies in the Pittsburgh region. We plan to engage our alumni and their networks for the resources needed by our emerging companies, *i. e.*, capital, technology, and entrepreneurial leadership. Further, many of our graduates wish to locate in these regions once they graduate, so access to networks in these regions is beneficial to them in launching their companies and/or careers. We are contemplating extending these networks to other technology/biotechnology centers with high concentrations of Carnegie Mellon alumni.
- Network building in the local community. The start-up process requires an extensive network of support for entrepreneurs, including funding for very early stage companies (pre-VC level). The Pittsburgh region has developed a cluster of state and foundation-funded initiatives that focus on the pre-seed funding and entrepreneurial support in areas of technology (Innovation Works and Idea Foundry), life sciences (Pittsburgh Life Science Greenhouse), digital chip and robotics technology (Pittsburgh Digital Greenhouse and Robotics Foundry). These organizations represent partners via an alliance with the university to provide a smooth transition from the university and business school environment into emerging companies. It is possible via this network for emerging companies to access ~\$1 - 1.5 million of investment prior to angel and VC involvement. Typically, these investments are not “priced” and the investment comes in the

form of a convertible note with warrants that are valued at the first round of institutional investment. In the following section we will illustrate how this network has been leveraged in the last few years to launch companies successfully out of the Tepper School. Beyond this alliance, there are also several organized angel groups that participate once early development, marketing, and management milestones have been achieved. These include LifeSpan, Blue Tree Capital Group, LLC, the Western PA Adventure Capital Fund, Smithfield Partners, and others. These groups have sufficient capital to bridge a company from the university to institutional venture capital both locally (via our local networks) and nationally (via our Boston and Silicon Valley hub networks).

Section Four – Recent Case Studies

1. PlexTronics, Inc.

PlexTronics began in our entrepreneurship classes. In the summer of 2001, Richard Pilston, a Ph. D. candidate in Chemistry from the Mellon College of Science visited the Donald H. Jones Center for Entrepreneurship. He believed the research he was doing in conductive polymers for his Ph. D. under Dr. Richard D. McCullough, Professor of Chemistry and Dean of the Mellon College of Science, was potentially of commercial value. He wanted to investigate how he could form a company to commercialize this technology after graduation. We suggested that he enroll in 45-886 Entrepreneurship, an introductory course at the graduate level in entrepreneurship. That fall, Pilston completed his Ph. D. and received an appointment as a post doctoral fellow in the Mellon College of Science. While his status as a post doc caused him to drop our course officially, we permitted him to audit the course to completion and to audit the Entrepreneurship Project course in the spring.

The business plan Dr. Pilston prepared and honed in these courses proved quite attractive, and we began actively to assist in the formation of PlexTronics, Inc. in April of 2002. Andrew Hannah, an Adjunct Professor in our entrepreneurship program at the Tepper School and a three-time serial entrepreneur, became interested in the project and agreed to serve as CEO of the company. One of us (Emerson) contributed some seed capital personally, recruited Eric Boughner, an MBA in the class of 2002 as the third founder, and began discussions on technology licensing with the Innovation Transfer Center. A world-wide license to the technology was granted by the ITC to PlexTronics only seven weeks after discussions began. Dr. McCullough agreed to contribute some seed capital and to serve on the company's Board of Directors. We also arranged for both seed capital and board service from Mr. Robert J. Gariano, a Carnegie Mellon graduate, who had a highly successful career in the plastics manufacturing industry.

Today PlexTronics, Inc. is housed in a local industrial park. The company employs 18 people and is capitalized above \$4.2 million. The company has produced working light-emitting diodes and photo-voltaic cells using its proprietary polymers and is negotiating joint development agreements with leading companies in the conductive polymer field. They were named to the Innovation World "21 List" as one of the 21 companies best poised for growth in the 21st century. In October of 2004, Fast Company Magazine wrote an article about the company which said, "PlexTronics may be sitting on the 'next small thing'". Red Herring described the company as a "nanotech start-up to watch". In addition, the Commonwealth of Pennsylvania has named the company as a "gazelle company", and has provided a benefit package totaling \$785,000.

2. ClearCount Medical Solutions, Inc.

ClearCount Medical Solutions, Inc. was a 2004 spinout of our program. Steven Fleck and Gautam Gandhi, two of the founders of ClearCount, were second-year MBA students in our program. Fleck had worked during the summer of 2003 at CardiacAssist, a local medical device company. There he met James D. Fonger, M. D., a well-regarded cardiothoracic surgeon currently practicing at Lennox Hill Hospital in New York City.. Dr. Fonger knew of an inventor who held U. S. patents covering the use of RFID technology to track surgical sponges and instruments in the operating room. The inventor had been unsuccessful in raising capital to support a start-up company that would commercialize these patents. Fleck and Gandhi enrolled in our Entrepreneurship course in the fall of 2003 and used this idea as their course project.

By the spring of 2004 they had become enthusiastic about starting the company. They met with the inventor and reached an agreement to assign the patents to the company, contingent upon success in raising the required capital. They also met with industry leaders, such as Johnson & Johnson, and with operating room nurses and surgeons to determine market acceptability. Using funds from our NASDAQ grant, they completed a working prototype of the scanning device. Their business plan won the Rice University Business Plan Competition, and they placed second in the Global Moot Corp Competition.

Today ClearCount Medical Solutions is located in Oxford Centre, Pittsburgh, PA. The company has commitments of capital exceeding \$500,000. They have attracted support from Idea Foundry, Innovation Works, and the Pittsburgh Life Sciences Greenhouse — three local economic development organizations. In addition, they won a \$100,000 SBIR grant to fund testing of their device at Stanford Medical School beginning in January of 2005.

3. EADevices, Inc.

EADevices, Inc. was another 2004 spinout of our program. In preparation for the inauguration of the Technology Commercialization Workshop course, the two of us visited a number of local companies during the summer of 2003 to see if they had technology or ideas that they were not using that could serve as the basis of student projects. Medrad, Inc., a local medical device company, contributed the idea of an energy-assisted biopsy needle for the gathering of tissue samples from lungs or other sensitive organs. A source of ultrasonic energy would be coupled to the needle to supply the cutting force, greatly reducing the pressure that would be required to penetrate the tumor.

This project was taken up by three students in the Technology Commercialization Workshop: Joshua Gerlick, a second year MBA candidate, Yogesh Oka, a senior computer science major, and Mark O'Leary, an M. S. candidate in mechanical engineering. Using funds from our NASDAQ grant, they built a crude working

prototype and tested it in simulated tissue (a grape suspended in Jell-O) and in animal tissue. Their business plan won the Global Moot Corp Competition in May 2004. The company is seeking investors to provide development and working capital. They have attracted interest from several local economic development organizations.

4. Biostics, Inc.

Biostics, Inc. was another 2004 spinout of our program. As part of its MEMS (Micro-Electronic Mechanical Systems) research program, Carnegie Mellon holds a patent portfolio in the production of tiny membranes on silicon. Biostics is the fourth company to be created to commercialize this technology for various applications.

Bryan Allinson, a second-year MBA candidate in 2004, worked with a research group in the chemical engineering department at the Carnegie Institute of Technology (Carnegie Mellon's engineering school) that was using the MEMS membrane technology to develop a group of sensitive biological sensors. Their research has the potential to serve as the basis of biological "lab-on-a-chip" and bio-sensor technology. Biostics was formed to develop and exploit this potential.

At this point, the company is negotiating a license of the technology from Carnegie Mellon University's Innovation Transfer Center. It is seeking SBIR and other grants to support further research.

Section Five –Summary, Conclusions and Issues

There is a role for an effective partnership between Entrepreneurship Centers and Technology Transfer offices – each brings its own skill sets and expertise to facilitate effective commercialization of inventions.

Note that this partnership may work differently in major technology hubs and centers of entrepreneurial activity (*e. g.*, Boston, Silicon Valley, San Diego, etc.) as opposed to smaller university-driven hubs like Pittsburgh, Philadelphia, Cleveland, etc.

Entrepreneurial community networks bridging the university with the community are much more established or mature in well developed centers such as Boston and Silicon Valley vs. regions such as Pittsburgh which are in the “development stage”. Therefore, in development stage regions it is more important for the technology transfer office and the business school to play a more proactive role in company formation. We have developed university-based programs to affect such a proactive role. Additionally it has been necessary for the university itself to assist in development of an entrepreneur support network in the community and in alumni hubs to facilitate funding and mentoring of very early stage companies. Both Carnegie Mellon University and the University of Pittsburgh have actively engaged in the creation of Commonwealth of Pennsylvania and foundation supported organizations such as Innovation Works (part of the statewide Ben Franklin Program), the Pittsburgh Life Science Greenhouse, the Pittsburgh Digital Greenhouse, and the Robotics Foundry. These organizations act as funding sources for early stage companies with funds being used for early stage technology and intellectual property development, to product prototyping, clinical testing and other activities that are difficult to fund via venture capital sources.

Despite these early stage support networks, we have identified a number of challenges as we work with young emerging companies in the university setting. These include the following:

- IP protection in a classroom/workshop format. In our courses we work with students on developing technology commercialization strategies based on their own ideas, as well as disclosures from the university and the community. During the course of classroom discussions there is often inventive material that evolves (shared ownership issues). Additionally, it is possible for these working groups to be considered as a public disclosure thus potentially jeopardizing patenting. So, both non-disclosure (public forum), and inventive contribution to IP by team members and classmates has emerged as a concern. This is somewhat different from the working group in the technical setting, where these issues are somewhat different and can be treated by existing university policies and procedures. Therefore, we have developed confidentiality agreements for use in our classrooms where such issues may exist.
- Team building and leadership development. One of the most important aspects of company formation is building the founding team and advisory structure very early on. Also splitting of founder’s equity and the equity structure is an

important subset of this issue. It is much easier to do this correctly in the first place than to have to redo it later. Therefore, as soon as it becomes apparent that a company is going to be formed and spun off, we actively counsel the participants in this regard. Introduction is also made to competent counsel. Along similar lines, it is often necessary to work with emerging teams to identify qualified and experienced team members, including CEOs, CTOs, and CFOs. These often come from our networks both locally and non-locally, including our alumni.

- Funding at early stage gap level. It is our opinion that when dealing with very early stage technology commercialization there is a necessity to have access to capital for prototyping, market and competitive research, patent searches and similar activities. While we have developed alliances in the community to provide funding when companies have actually been formed, the pre-company stage that we deal with requires access to small amounts of capital to support the investment decision by these economic development groups. A grant from NASDAQ provided such capital for some of our recent spin off companies. We are currently exploring the feasibility of creating a pool of funds to support future activities, and we are planning to make such investments as convertible notes so that the Entrepreneurship Center can benefit from the equity upside of these companies in the event that they are successful.
- Alignment of interest of all constituencies. As with any new venture, it is essential for an alignment of interests of the constituents, including founders, investors, company, etc. In the case of university-based spinoffs, it is important to recognize the interests of faculty, students, founders, university administration as well as the business school. All parties need to support and benefit from the spinoff in the event of success, and to share in the risk in the event of problems (which almost always occur). In a university setting one must, of course, be very mindful of conflicts of interest for faculty as well as conflicts of commitment. These should be addressed by effective university policies (see below).
- Effective Technology Transfer Policies (CMU approach – see Appendix A for details).

Figure 1 - EFFECTIVE PROGRAM BEGINS WITH ACKNOWLEDGING ALL STAKEHOLDERS

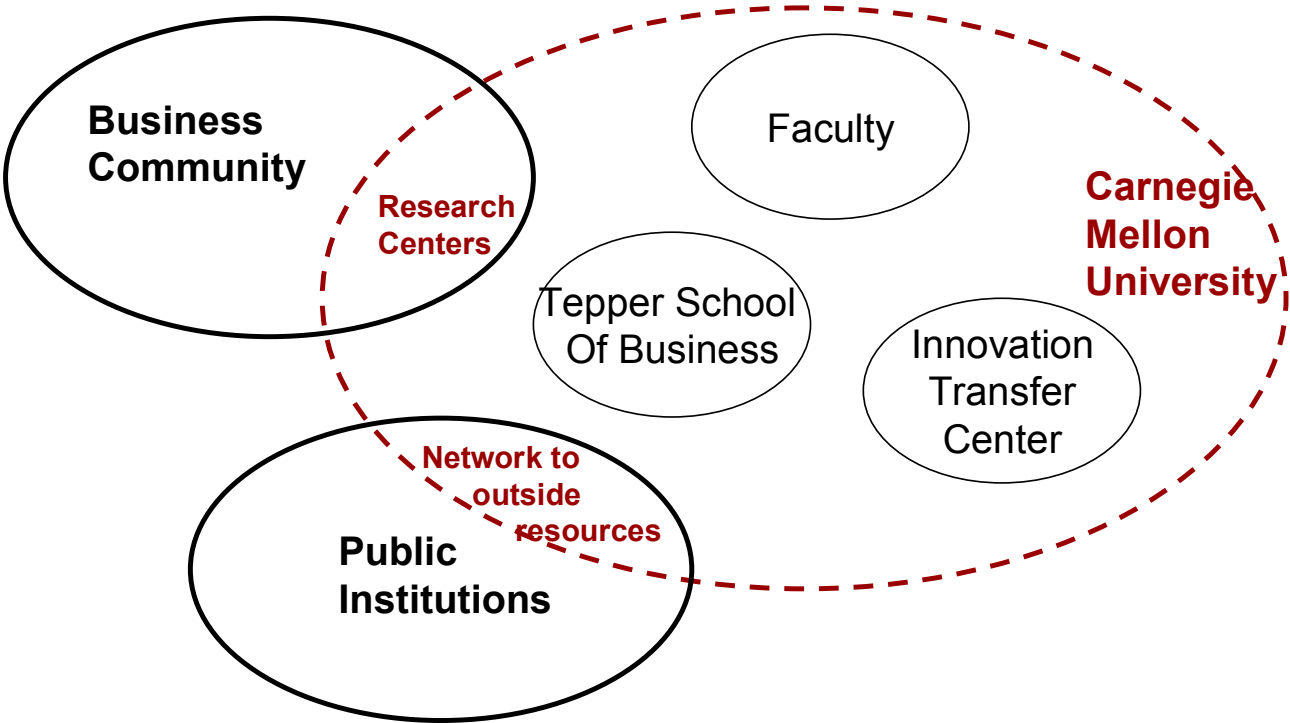
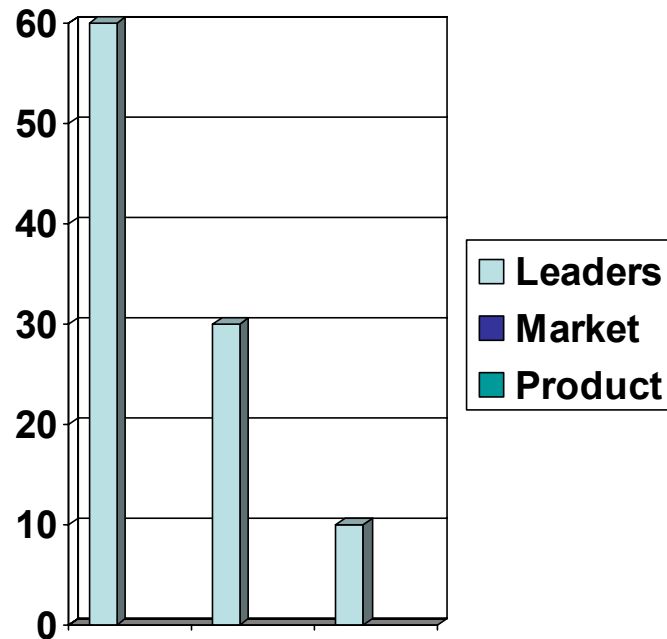


Figure 2 – Common Failure Modes



- Experiential learning impacts ability to anticipate failure modes at all stages of company life cycle

Appendix A – Overview of Carnegie Mellon University Technology Transfer Policies

From 2000 through 2001, the President and Provost of Carnegie Mellon University charged the University Research Council (URC) to undertake a thorough examination of the University's technology transfer policies, with a view toward replacement or major modification of those policies. One of us (Emerson) was a member of the URC and participated in the revision of these policies. The idea was to create technology transfer policies that were simple, fair, clear and fast. In addition, the new policies sought to align the interests of the university with economic development efforts within the Pittsburgh region, and to assist the university in attracting and retaining the highest caliber faculty researchers. The URC noted that the policies of many universities, by focusing on maximizing revenue to the university, place the university in an adversarial role with respect to faculty researchers who seek to commercialize the results of their research. The URC recommended a different approach in which the university becomes a partner with researchers in efforts to commercialize their research.

The final report of the URC was submitted to the President and the Provost on November 4, 2001. The authors were the members of the URC listed on the first page of the report. It represented a concerted effort over nearly a two-year period to create a model policy for streamlining innovation transfer from the university to the commercial marketplace. During 2002, Carnegie Mellon University substantially adopted and implemented the recommendations of the URC. To our knowledge, the URC report has never been published, although a PowerPoint presentation of portions of the report has been on the Carnegie Mellon web site since that time.

While some of the discussion is specific to Carnegie Mellon and to Pittsburgh, we feel that the issues dealt with by the URC are broadly applicable to the research university setting. We include excerpts from the report here in the belief that the discussion will be relevant to others addressing issues related to technology transfer and commercialization of university research.

**Carnegie Mellon University
University Research Council
Excerpts from the
Recommendations from Deliberations of 2000-2001 Academic Year**

URC Members:

Christina Gabriel, Vice Provost for Corp. Partnerships and Tech. Dev.,
Chair
Michael I. Shamos, Inst. for eCommerce & Language Technologies Inst.,
Vice Chair
Margaret Stanko, Faculty Senate, Executive Officer
S. Thomas Emerson, Donald H. Jones Center for Entrepreneurship
Kaigham J. Gabriel, Robotics Inst. & Electrical and Computer Engineering
Paul J. Hopper, Department of English
Anne R. Humphreys, Learning Systems Architecture Lab
Peter Lee, School of Computer Science
Thomas A. Longstaff, Software Engineering Institute
Jonathan S. Minden, Biological Sciences
Eric H. Nyberg 3rd, Heinz School & Language Technologies Institute
Henry R. Piehler, Materials Science and Engineering
Joel M. Smith, Office of Technology for Education
Craig M. Vogel, School of Design
Howard D. Wactlar, Vice Provost for Research Computing & Computer Science

Abstract

The year 2000 marked the twentieth anniversary of the passage of the landmark Bayh-Dole Act, which gave universities the right to own and commercialize inventions resulting from government sponsored research. It was also the seventh year of operation of Carnegie Mellon's Technology Transfer Office. The University Research Council (URC) has spent the 2000-01 academic year considering what has been learned during that time, both here at Carnegie Mellon and by other universities across the nation, about the commercialization of university innovations. Based on this analysis, the URC proposes a new approach for enabling innovation and innovation transfer at this university. It is designed to achieve much greater success by drawing upon Carnegie Mellon's distinctive culture, which stimulates and supports interdisciplinary, problem-solving creative activity. Through the formation of a new entity that the URC would call the "Innovation Network," Carnegie Mellon can strengthen its existing education, research and service programs related to entrepreneurship and commercialization, link them with each other, and build a set of active connections with the university's external communities. In this way, the Carnegie Mellon University environment will become more attractive to the faculty, staff and students who would be most likely to enhance the quality and reputation of the university's research and education programs.

The URC has also reviewed Carnegie Mellon's existing policies and procedures related to commercialization and technology transfer. The URC recommends several changes that

would improve the university's performance in these areas and support the Innovation Network model.

I. Executive Summary.

Carnegie Mellon is recognized nationally for its extraordinary success at innovation, problem solving and interdisciplinary collaboration. The opportunity to work closely with experts in other fields is a key attraction for many of the outstanding faculty, staff and students who choose to come to this university. Not only does this culture create an intellectually stimulating environment, but it is also conducive to generating commercially promising innovations that can contribute to economic growth, especially in the Pittsburgh region.

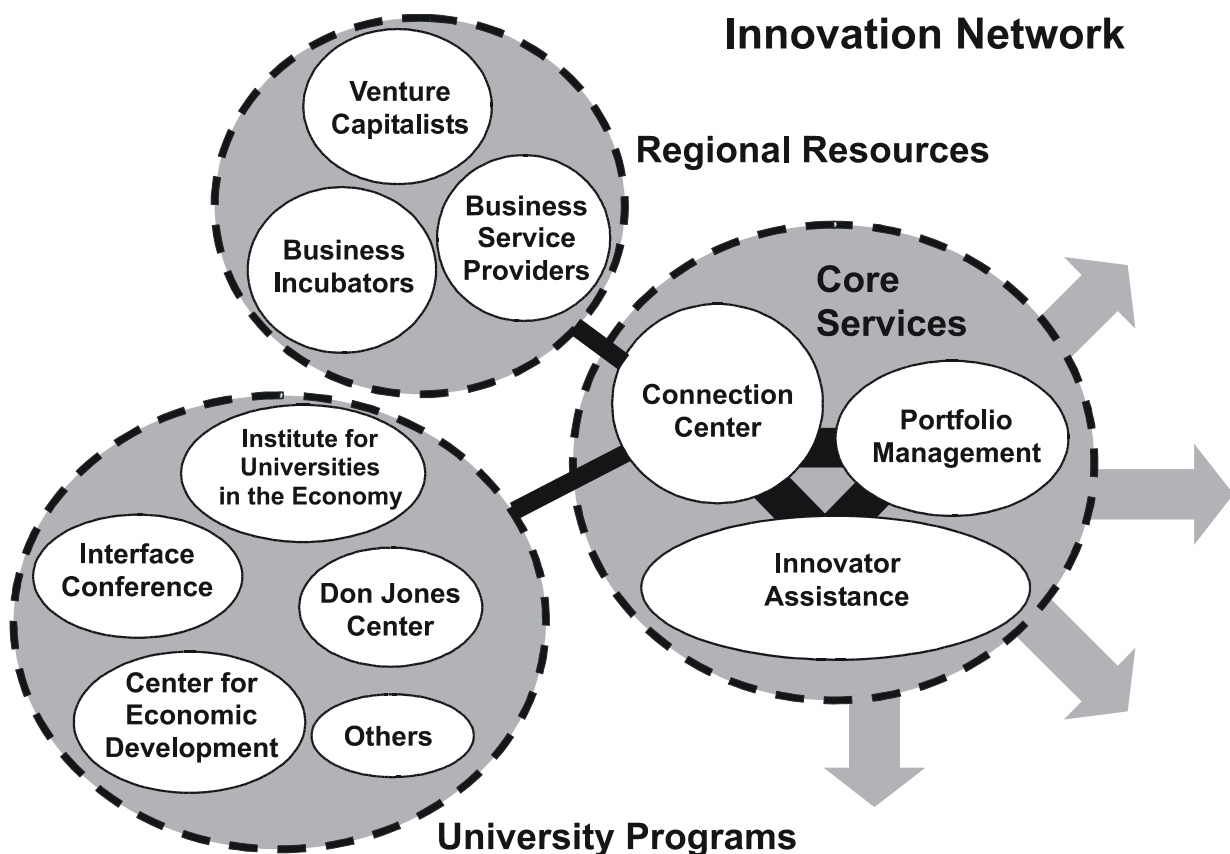
Given the strength and pervasiveness of this culture, there is an overwhelming sense among campus innovators and the Pittsburgh regional community that significant improvements should be possible in the commercialization process at Carnegie Mellon. The University Research Council (URC) was charged “to develop a new vision for enhancing Carnegie Mellon’s contributions to society through the commercialization of the results of certain research and education efforts, to evaluate the university’s existing policies relevant to the innovation process, and to recommend modifications as necessary to align them with the new vision.” In carrying out this charge, the URC solicited input from members of the university community as well as others in the region. Information and perspectives were also gathered from a range of sources in other parts of the country and the world.

The scope of the URC’s deliberations did not extend to a broader consideration of corporate partnerships. University policies for industry affiliates or centers programs, the use of university labs by commercial firms, applied research and prototype development, etc., were not part of the discussions of this academic year. These issues will require in-depth consideration and may be taken up by the URC as a next step. The URC also did not make recommendations on issues of courseware ownership, technology for education, distance education, and the university’s role in developing and marketing courseware. The URC believes this set of topics should also be considered carefully within the next two or three years.

This report describes the results of the URC’s review and analysis of the university’s policies and procedures for commercialization. It puts forward a proposal for Carnegie Mellon to create an “Innovation Network” that would encompass, or make connections to, all campus activities that enable innovation and innovation transfer. The Innovation Network would also build stronger links to relevant organizations and individuals outside the university. An important goal of this approach is to open the university’s innovation transfer and commercialization process to active engagement by people and organizations who have quality assistance to offer and who have a stake in improving Carnegie Mellon’s contributions to the regional economy and beyond. The Network would also stimulate activities across the campus that enable innovation and strengthen Carnegie Mellon’s distinctive entrepreneurial culture.

I. A. Innovation Network.

A schematic representation of the Carnegie Mellon Innovation Network is shown below. The arrows emphasize that the overriding objective is to move innovations effectively from within the campus to the outside world. Commercialization assistance would be tailored to the needs of each innovator as a service to the campus community. The Connection Center would link innovators to university events and programs offering education and training, research and benchmarking. It would also provide information about and introductions to resources that the region has to offer, such as the investor community and service providers for individual entrepreneurs or spinoff companies.



The current Technology Transfer Office (TTO) would cease to exist in its present form in this model, although many of its functions would continue to be carried out within the Innovation Network. Commercializable innovations at Carnegie Mellon often result from activities in the arts and humanities and therefore the current focus on “technology” needs to be broadened. In addition, the Innovation Network would enhance activities that stimulate innovation and facilitate its transfer, placing a particular emphasis on expanding promotion and marketing activities well beyond what the TTO can currently offer. These

“enabling” functions would be separated from the administrative and regulatory functions that the university must perform by law to complete any licensing or commercial transaction. The most effective approach might be the creation of two entities within the Innovation Network, one to focus on assistance for innovators and entrepreneurs which might be called “innovator assistance and one to handle administrative and regulatory functions as well as management of the university’s intellectual property portfolio during the years after licensing agreements are signed. This latter set of functions could be called “portfolio management.” The report offers a set of suggestions for how these activities could be structured, organized, managed and evaluated. Finally, note that the URC has chosen to use the word “innovator” rather than the more narrowly construed “inventor” to describe an individual who creates a new concept with potential value for commercialization or other broad dissemination outside the university.

The Carnegie Mellon Innovation Network will provide:

- **Active assistance** tailored to an inexperienced innovator’s needs.
- **Active facilitation of connections** to Carnegie Mellon Alumni and regional resources for innovators.
- **A higher volume** of licensing activity, enabled by university policy changes and process improvements for innovation transfer.
- Space for spinoff company **incubation**.
- **Education initiatives** from the basics of the commercialization process to programs designed to stimulate entrepreneurship and an innovative campus culture.
- Rigorous **research** in the new Carnegie Mellon **Institute for Universities and the Economy**.
- **Evaluation** of progress and outcomes; **benchmarking** against programs in other universities and regions; **modification of programs** over time, based on evaluation and benchmarking results.
- A national leadership position through participation in national conferences and peer-reviewed publications.

I.B. Policy Recommendations.

A commitment to enabling innovation and innovation transfer should be an integral part of the university’s mission to benefit society. Commercialization assistance should be considered as a service that Carnegie Mellon needs to provide for its community of faculty, staff and students.

In its licensing activity, the university’s goal should be to maximize both financial and non-financial benefits over the long term from its relationship with each potential licensee. Procedures should be designed to be **simple, clear, fair and fast**. That is, even

from an inexperienced innovator's point of view, each step of the process and its rationale should be made easy to understand. There should be a sense that policies are applied consistently. Finally, decisions must be made without delay, recognizing that the commercial value of an innovation usually depends critically on the licensee's ability to bring a product to market more quickly than a competitor can do.

The URC proposes several changes in the Intellectual Property Policy that will be necessary for this new, broader approach to be successful:

- Proceeds from the transfer of innovations should be shared by all creators, whether or not they have faculty status. In particular, the URC suggests a change that would enable staff members to be treated no differently from faculty researchers in this regard when they contribute in a similar way to open-ended research activities and the innovations that result.
- The university should demand a smaller percentage of equity in spinoff companies as well as of licensing revenues. The current 15% should be reduced to 5%, especially in those cases where the university elects not to invest its own resources in commercializing the innovation.
- In order to offer new and broader programs to encourage and enable innovation across the campus, the URC recommends that Carnegie Mellon change the algorithm that is currently in place for revenue-sharing among innovators, their departments and the university administration. The university should follow the example of other universities such as Stanford, by drawing a percentage of its gross proceeds from commercialization to pay for the more extensive core services that the Innovation Network would provide.

While the URC believes that the text of the policies addressing conflict of interest and conflict of commitment needs no modification, it may be necessary to change the oversight process to draw upon a new oversight mechanism, such as a standing or ad hoc committee, to advise the Provost rather than delegating authority entirely to the department head in many cases. At the suggestion of the Chair of the Faculty Senate, the URC also recommends that the university consult closely with faculty creators prior to making its decision about whether to commercialize their innovations, to ensure that any moral or ethical concerns are taken properly into account. Finally, the URC recommends that all the policies and guidelines for commercialization procedures be simplified so that they are easier to understand and interpret by those who will need to follow them.

I. C. Vision.

In interviews with individuals across the Carnegie Mellon campus and in the Pittsburgh regional community who have worked with the University's commercialization process, the URC heard a strong consensus that these constituencies continue to have significant concerns about the process. Central to the discontent is a sense that the university interacts with innovators as though it were in opposition to them, rather than showing enthusiasm for working toward a common goal. With the creation of the Innovation

Network, the URC proposes a different process that emphasizes collaborative problem-solving, and aims to put a new set of incentives in place to support this approach.

Vision: Carnegie Mellon should encourage the creation of innovations on campus and then to facilitate the timely and effective transfer of those innovations to the outside community. When commercialization would be the most effective mechanism for this transfer, the university needs to have policies, procedures and services in place, continually evaluated and modified as necessary over time, to ensure that the transfer proceeds smoothly and without unreasonable barriers or delays.

The new approach recommended here positions the university as **facilitator rather than adversary**. It draws upon and supports the university's **collaborative, entrepreneurial culture**. It puts stronger and more productive **campus-wide and regional connections** into place. As a result, the URC believes that the Innovation Network will enhance the university's reputation, make it easier for Carnegie Mellon to attract and retain world-class talent, and increase the probability that university innovations will lead to commercial success that will bring significant financial and other benefits to the university and play an important role in the revitalization of the Pittsburgh regional economy.

II. Carnegie Mellon Innovation Network.

Successful entrepreneurial economies thrive on the connections people make. The energy for creating and commercializing innovations is strongest when university researchers, investors, and business leaders can work together effectively as members of one community.

Carnegie Mellon intends to create an **Innovation Network** that will stimulate an innovative culture across the campus and enable the innovations created within the university to be transferred smoothly to benefit the community outside. Programs and services sponsored by the Innovation Network will be designed:

- To develop productive partnerships among and between faculty, staff and students;
- To provide a comprehensive university resource for faculty, staff and student innovators and
- To facilitate a strong set of connections between university-based innovators and the investment and business community, particularly in the Pittsburgh region.

A primary goal of the Innovation Network will be to increase the level and effectiveness of the university's commercialization efforts.

Problem-focused, collaborative research is a distinguishing feature of the Carnegie Mellon culture. The opportunity to work in interdisciplinary teams is a key attraction for many of the outstanding faculty, staff and students who choose to come to this university.

Carnegie Mellon's interdisciplinary culture fosters an intellectually stimulating environment in technical fields as well as in the arts and humanities that often leads to the generation of commercially promising innovations. The purpose of the Innovation Network is to draw upon as well as support this creative, risk-taking culture and to improve the university's ability to contribute to the creation of broadly useful new products and processes as well as to economic growth, especially in the Pittsburgh region.

The Innovation Network will improve the understanding of innovation and innovation transfer across the campus and within the larger Carnegie Mellon and regional community with a coordinated set of new education, research, and innovator-assistance initiatives. For example, students, faculty and staff will have a single point of entry that will enable them to know where to go and whom to ask for help with the development and transfer of their own innovations. Alumni will know how to contribute as mentors or investors for companies spinning out of the university. Members of the university community will be able to share the experiences they have had in entrepreneurship and technology development with their students and colleagues. And investors and the business community will find it easier to navigate university processes and administration to build new and expanded enterprises based on university innovations. The Carnegie Mellon Innovation Network will provide:

- **Active assistance** tailored to an inexperienced innovator's needs — The Network will provide assistance to the innovator for developing an effective presentation of a new concept, determining an appropriate commercialization avenue (*e.g.*, licensing or new enterprise formation), developing a business and marketing plan, and pursuing financial and other resources to carry out the plan. Guidance for innovators will draw upon the expertise of a broad network of individuals, thus developing high-quality packaging for Carnegie Mellon innovations before they are presented to potential licensees or investors.
- **Active facilitation of connections** to Carnegie Mellon alumni and regional resources for innovators — a "Connection Center" will develop a network within and beyond the campus to provide connections to investors, business service providers, attorneys, technology and business mentors, candidates for key management positions in spinoff firms, etc. In the business commercialization process, the university will allow innovators to choose service providers either inside or outside the university for all innovation transfer functions except those for which the university is required by law to be the sole provider of the service.
- **A higher volume** of licensing activity, enabled by university policy changes and process improvements for innovation transfer. For example, experienced innovators may choose to have minimal university involvement and thereby reduce royalties and equity owed. Templates for legal documents will be simplified and clarified to reduce negotiation delay. Time to make decisions on university innovation investments will be reduced by involving more experienced reviewers in frequent, real-time decision meetings.

- Some space may be made available (for example, in the Pittsburgh Technology Center facility) for spinoff company **incubation**, especially when collaborations with Carnegie Mellon research groups continue.
- **Education initiatives** — The Network will provide access to
 - education and training in the basics of commercialization;
 - courses that bring an entrepreneur’s perspective into the classroom;
 - faculty-to-faculty courses to stimulate interdisciplinary collaboration.
 - courses that focus on the “how-tos” of developing a commercial product, bridging the tension between promotion and production, and product innovation;
 - expanded entrepreneurship programs for graduate and undergraduate non-business majors and regional entrepreneurs; and
 - entrepreneurship-focused campus events.
- Participation in the new Carnegie Mellon **Institute for Universities and the Economy** — Rigorous **research** on entrepreneurship and the innovation process, technology policy, industry sector evolution, and regional economic development. The institute will evaluate and promote the regional and national economic impacts of university research and training through multidisciplinary research, support of educational programs and university policies designed to advance the economic impact of universities, and support of public policy concerned with regional development. For some studies, the institute would use Carnegie Mellon and the Pittsburgh regional entrepreneurial community as a test bed.
- **Evaluation** of Innovation Network progress and outcomes; **benchmarking** against programs in other universities and regions; **modification of programs** over time, based on evaluation and benchmarking results.
- A national leadership position through participation in national conferences and peer-reviewed publication.

III. Requirements for Creating the Innovation Network

The Innovation Network will be managed as a loose federation of interconnected entities overseen by the university Provost. A director of the Innovation Network will be appointed to manage the core services and their connections to university programs and community resources. A key responsibility of the director will be to facilitate discussion and action, promote and foster synergies between and among all stakeholders, and communicate progress to all stakeholders.

Although technology patenting and licensing, along with some marketing and business incubation functions, are currently handled within Carnegie Mellon’s existing Technology Transfer Office, the Innovation Network will address these functions in a different way while also offering the other new activities and services listed above. It is important to note that the Innovation Network will highlight “enabling” functions — related to the identification, articulation, and promotion of an innovation — and separate

them from functions which concentrate on protection of intellectual property rights, satisfying regulatory requirements, and negotiating certain clauses in legal documents. Emphasizing the “enabling” functions will be a significant change from current university practice and may require additional staff and resources dedicated to these tasks.

Some of the new and enhanced activities that the Innovation Network will need to develop are listed below:

- **Connection Center.** The Connection Center constitutes the heart of the Innovation Network. Its goal is to strengthen the interpersonal network that links innovators with campus and community resources such as investors, technology and business advisors, and professional service providers. It will also link them to each other and to the community of Carnegie Mellon alumni and friends so that more experienced innovators can mentor less experienced ones. It will provide basic information and a link to deeper educational resources on campus and in the community, so that even novice innovators will quickly be able to learn the process, they will need to follow for transfer of their innovation and to make informed choices at each step along the way. With quality screening and guidance from Innovation Network staff, the Connection Center will also enable innovators to seek and evaluate service providers from the community using a “food court”-style forum, with space for meetings, information in pamphlet and book form, and a database and web presence. Over time, as this network grows, this Connection Center hub will become a well-known regional community presence, and will become more and more valuable to campus-based innovators at several stages of the commercialization process.
- **Mentor-Investor Community Database.** The Innovation Network will draw upon a large number of experienced innovators, entrepreneurs, and technology and business professionals who have connections to Carnegie Mellon. Many faculty, staff, and alumni across the nation have expressed the desire to participate in the process as mentors, investors, and consultants to contribute to the success of less experienced innovators and support the university. A database of these contacts will be created, and the dedicated time of a key staff member will be provided within the Connection Center to build and maintain relationships and to broker appropriate connections with innovators.
- **Market Research.** Innovators often cannot predict the most promising commercial application for their innovation, and may not have sufficient knowledge of the targeted industry sector to be able to present a compelling case for investment or licensing. The Innovation Network will develop or purchase professional market studies relevant to each innovation and for classes of related innovations. In addition, a strategy for making connections to key individuals in key companies in the sector of interest will be developed in each case. The Innovation Network will have several commercialization specialists on its staff, chosen for their deep knowledge about technologies and industry sectors representing the university’s strongest target application areas. Ideally, they will also have their own well-developed networks of connections based on their personal experience in those sectors. These specialists will be able to interpret

market data in light of this knowledge and provide a dramatic improvement in the university's ability to commercialize its innovations effectively.

- **Enabling Faculty participation.** Many Carnegie Mellon faculty have extensive experience with innovation and commercialization. Sharing that knowledge with students who will themselves often become entrepreneurs, or acting as mentors to other faculty, contributes to the success of individual innovators as well as to the health of the entrepreneurial culture on campus and in the community. However, the departments where commercializable innovations are most likely to emerge, and where faculty are most likely to have experiences to share, also tend to be the same departments where demand for courses is high and faculty teaching loads are large. Funding to enable those departments to support a small surplus of faculty lines would enable some faculty to teach courses to potential collaborators in other fields, to serve on innovation review committees or as mentors for university innovators, or to take a leave of absence to pursue a short-term entrepreneurial activity in the Pittsburgh community. For example, starting in the fall term, 2001, a faculty researcher in the biological sciences will teach a course to a group of interested faculty colleagues in other research fields. This **“Foundations to Frontiers”** course will first teach basic introductory concepts in the instructor's field, and then present several unsolved research problems that are the current “grand challenge” issues in the field. Once basic concepts are understood, experts in other fields will be more likely to see the contributions their specialized expertise could make toward solving the grand challenges collaboratively.
- **Expansion of Entrepreneurship Courses and Training.** The Don Jones Center for Entrepreneurship within the Graduate School of Industrial Administration (currently the Tepper School of Business) is expanding its course offerings in entrepreneurship, and several of the other schools on campus are developing programs in entrepreneurship for non-business majors. Investment is needed to meet the demand for entrepreneurship education from both undergraduate and graduate students majoring in other disciplines. Additional sections of existing classes at the business school will be offered to interested students, with an intense short-course offered first to provide the essentials of the required background. All of the class sections will include both business and non-business majors, so that students will mix and work with each other on team projects, promoting cross-fertilization. The university would also like to scale up its offerings in entrepreneurship education for executives from regional companies, which can be focused on the needs and interests of particular industry sectors. Finally, staff from the sponsored research and technology transfer offices would like to expand the training they offer to members of the Carnegie Mellon community who do not already have substantive experience with the university's policies and procedures for patenting, licensing, and new venture formation.
- **Incubation space.** Carnegie Mellon's Pittsburgh Technology Center building offers high-quality space where spinoff companies could be located adjacent to labs where their research collaborators work. However, the facility's costs are high relative to the cost of incubator space elsewhere in the region, particularly

outside the city limits. A subsidy to help defray these additional costs would enable new, high-growth companies to work more closely with university researchers while they are in the early phases of development, when such collaboration is most critical to their success.

- **Campus and Community links; Events.** The Innovation Network will sponsor events on campus (such as an “Innovation Fortnight,” which a member of the URC proposed as an annual two-week period of innovation-focused seminars and conferences, and the annual student-run “Interface” technology-business conference) that are designed to encourage greater understanding of innovation and foster a culture of entrepreneurship across the campus and in connection with the regional community. In addition, Carnegie Mellon will participate more fully in related programs sponsored by other regional organizations, such as the educational programs of the National Foundation for Teaching Entrepreneurship, the Pittsburgh regional EnterPrize business plan competition, and Leadership Pittsburgh.

IV. Operational Suggestions for Innovation Transfer Process

Carnegie Mellon's goal for innovation transfer is to enable university-generated innovations to find an appropriate path out of the university for broader use in society, and to offer services to innovators as needed so that this transfer will be effective in each case. To do this, the Innovation Network must provide a process that draws upon a variety of resources, both from within the university and from the community.

Innovation transfer may be described as a packaging and marketing function. A concept, idea or invention must be shaped and articulated, or "packaged," so that it can be presented effectively to those constituencies, or markets, that might find it of value to them. Therefore, the university's focus should be on guiding innovators as necessary to develop a convincing case for the worth of their innovation to potential markets, making a decision about whether to invest university resources, and then seeking and closing a deal with an appropriate licensee outside the university to complete development and dissemination of the innovation and its derivative products and processes.

The path followed by an innovation through this process is depicted in the figure below. An innovator or group of innovators, who may include faculty, staff, or students, present a rough description of their innovation, concept, or idea to a front-door gatekeeper, labeled as the "initial triage" point in the figure. The gatekeeper determines what level and character of guidance the innovators will need to develop their concept and make the case for university investment.

If help is needed, it could take a variety of forms. The gatekeeper would assign a "coach" to the innovators to provide this help by drawing upon university and community resources. Coaches would be responsible for providing guidance well matched to an innovator's level of experience. This guidance might include such things as preliminary market research and connections to mentors outside the university. The coach would also

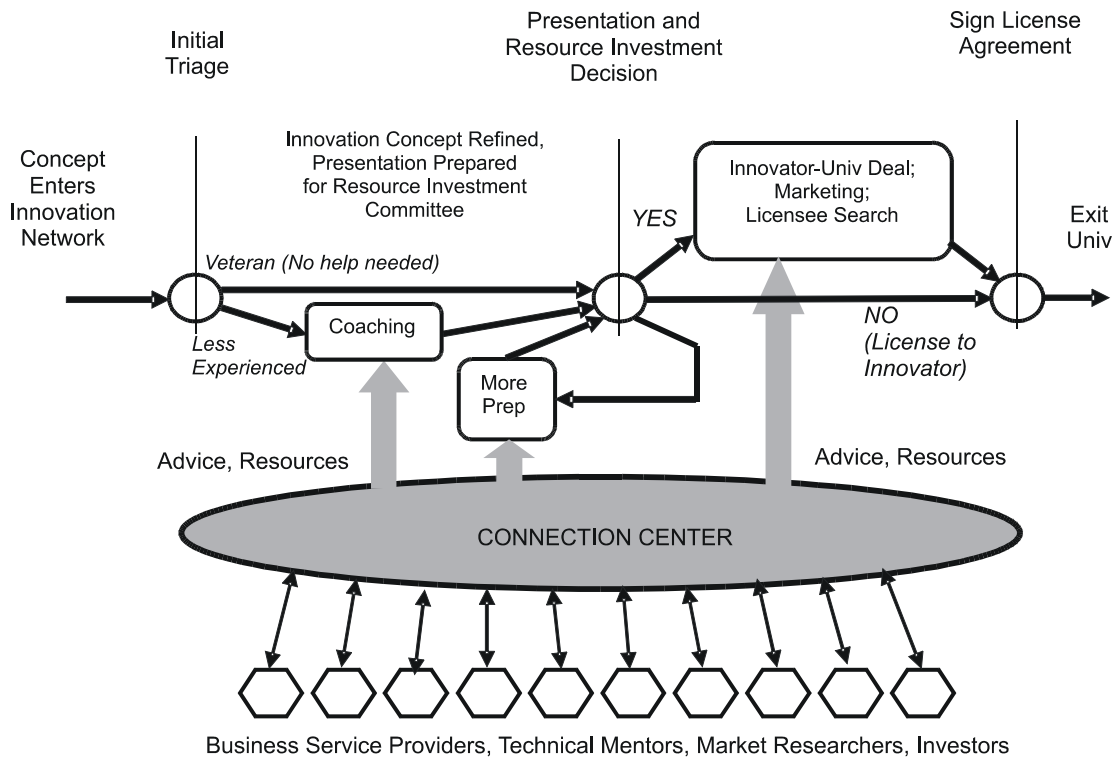
work with the innovators as they prepare their case to ask the university to invest its resources in patenting, marketing, and other tasks required to commercialize the innovation. Each innovation is different and will likely require a different level of attention during this initial pre-decision phase, although only nominal university resources other than staff time will be used.

If no help is needed in this phase, which would likely be the case when the innovators are experienced veterans, then no coach is assigned.

Key to the success of this process will be the quality and timeliness of the investment decisions that the university must make for each innovation. The director of the Innovation Network, reporting to the Provost, would be responsible for these university resource allocation decisions. To advise the director, the URC proposes the formation of a standing Resource Investment Committee. This group would be composed of faculty, staff, alumni, and others who have been properly screened and who agree to confidentiality. In order to conduct a fair and expert evaluation of the potential of each innovation, a range of area expertise will be required among the committee members. In addition, it may be necessary to draw upon individuals outside the university in particular cases. The committee would meet as often as necessary (probably weekly) and would be larger than necessary so that meetings could be scheduled even in the absence of several committee members. With help as needed from Innovation Network coaches, innovators would make carefully constructed presentations in real time to the committee and would provide backup information in writing. The committee would evaluate the innovation based on this material and make an investment recommendation in each case to the director of the Innovation Network.

If a decision is made to invest, the committee would also recommend a list of action items to be accomplished with university and community resources for the next phase, which would likely include intellectual property protection, active marketing, and negotiation with potential licensees. The university's investment would cover patenting costs, market research services and other business services contracted to outside firms, travel, and so on.

The final step in the transfer process, after a licensee is identified and negotiation underway is to draw up the formal license agreement. It is at this point that the Innovation Network's Portfolio Management function first becomes involved. Portfolio Management would be responsible for coordinating the final stages of negotiation, ensuring consistency with university policy, and appropriate signatures. In the following years while the license agreement is in effect, Portfolio Management would also assume responsibility for monitoring compliance of the licensee to the terms of the agreement, verifying that milestones have been achieved, invoicing for royalty payments, and watching over the university's intellectual property portfolio to take appropriate action in cases of patent violation.



The Innovation Network's Connection Center plays a role at several stages of the process. Connections to service providers, mentors, and investors will become more effective over time as the Network gains experience and becomes known to the broader Carnegie Mellon community. It will be especially valuable, for example, for campus innovators to engage the interest of alumni who have skills, experience, or financial resources to offer. An important collateral objective of the Innovation Network is to deepen and strengthen the bonds between the university and its alumni, industry partners, and organizations in the Pittsburgh regional community. The Connection Center offers a means toward that end.

As organizations responsible for providing services to the university community, the Innovator Assistance and Portfolio Management functions, in particular, ought to take advantage of best practices that have become common in customer service industries. For example, staff in these offices should be using one of the standard commercially-available information systems to track the progress and timing of each innovation transfer as well as relationships with all of their "customers" on campus and outside. To evaluate and shape the Innovation Transfer process over time, the URC recommends that the Innovation Network develop a set of quantitative and descriptive metrics that can be tracked and monitored. For example, these could include the number of concepts that enter the front door, the number of presentations made to the Resource Investment Committee; the time elapsed between various checkpoints in the process, the number of marketing interactions, and the number of concepts successfully licensed during a given interval. Taken in the aggregate along with the measures of royalty income published by the Association of University Technology Managers, a set of carefully defined metrics

could enable the university to use principles of continuous improvement to build greater effectiveness over time and provide quantitative data to be used in making staffing and investment decisions.

A rough estimate based on current levels of activity at the university indicates that the following staff would be necessary to support the director of the Innovation Network in managing this process effectively:

- 1 gatekeeper at the front door (this position may rotate with other functions).
- 3 coaches.
- 2 marketing specialists.
- 2 licensing officers.
- 1 administrative assistant.
- 1 financial manager.

Finally, in order to offer new and broader programs to encourage and enable innovation across the campus, the URC recommends that Carnegie Mellon change the algorithm that is currently in place for revenue-sharing among innovators, their departments and the university administration. The current model returns half the proceeds realized from a given docket, after covering that docket's expenses, to the innovators, one-fourth to their departments, and one-fourth to the administration. This remaining fourth has amounted to roughly half the TTO's operating costs in recent years. As a result, general university funds have been required as a subsidy for the remainder. In addition, a substantial debt has accumulated to date, representing the aggregate of docket expenses for unsuccessful commercialization attempts and those cases that have not yet begun to generate revenue. Note that Carnegie Mellon chose to invest the capital gains from the Lycos transaction toward construction of Newell-Simon Hall; had these funds been reinvested in the TTO, the office could have operated for several years without a subsidy. The URC believes that the appearance of a need for subsidy currently creates pressure for short-term revenue generation, whether or not intended, that are destructive to the university's service mission for this function.

The URC believes that the university should not need to subsidize innovation transfer on an annual basis. The Innovation Network must be judged on its ability to cover its costs as well as bring additional benefits to the university, and must be held accountable for its ability to meet this objective. Revenue beyond self-sufficiency will enable the university to support new initiatives.

The URC notes that other major universities deduct 15% from their commercialization proceeds to cover the expenses of their licensing offices, prior to distributing these revenues among the innovators and university units. The URC proposes likewise that Carnegie Mellon should set aside a fraction of the university's proceeds from commercialization (after covering legal expenses) to offset the Innovation Network's operating expenses.