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Abstract

The potential of the Ignatian Pedagogical Paradigm (IPP) is realized in the reflective actions of students after they leave the Jesuit educational setting and go out into the world. With developments in science and technology accelerating, and worldwide dissemination immediate, the imperative to infuse the IPP into areas driven by science and technology is clear. It is this imperative which draws us to the global biotechnology industry. This paper presents a short overview of the industry, describes how "science-business" differs from traditional business, and discusses the process by which the IPP – context, experience, reflection, action and evaluation – has been developed in the Business of Biotechnology program at the University of San Francisco (USF). The cases developed to exemplify the IPP are "Organized Religion and the Business of Biotechnology," "Humanist Measures for Success in Bio-Business," and "The Poor and Marginalized." In addition, the Business of Biotechnology program utilizes the Biotechnology Innovation Expertise Model (BIEM 2.0), which identifies a recognized complement of the disciplines needed to bring breakthrough bioscience to a commercial product. These disciplines are readily present at Jesuit universities, which can, in turn, directly support education of value to the global biotechnology industry.

Introduction

There are times in human history when science and technology make an unprecedented impact on humans and the world in which they live, and, in fact, set humanity on a course previously unimagined. Obvious examples include the printing press, telecommunications and computers, and modern medicine. The significance of a scientific breakthrough or a new technology is typically not understood at its outset, and the actual global adoption of a technology often took decades. Today, however, scientific breakthroughs and new technologies are emerging at an unprecedented rate, information can be shared globally within seconds, and worldwide technology adoption can be implemented within months.

In 2003, the genetic decoding of a severe acute respiratory syndrome (SARS) virus from a single patient took six days of round-the-clock work by a

Canadian team, while a Centers for Disease Control (CDC) team, working in parallel in Atlanta, added further essential genetic details two days later.[1] SARS was determined to be different from any previously decoded viruses found in humans or animals by yet another team at University of California San Francisco (UCSF) in San Francisco. This feat was accomplished within a single weekend.[2] The genetic decoding of SARS was a global scientific effort, led by the World Health Organization (WHO) and involving "115 national health services, academic institutions, technical institutions, and individuals."[3] It was only possible through what is now considered everyday communications technologies – voice, conference calling, the Internet, computers, and information sharing, all alongside the will and intent of the scientists, scientific expertise, and available equipment.

This moment of global crisis reveals the fabric of the world in which our students will live, work and contribute. It is a world in which individuals, both independently and as participants in larger organizations, can expect to be global actors. As a result, infusing the Ignatian Pedagogical Paradigm (IPP) into educational programs in fields driven by science and technology carries great urgency. And this imperative draws us to the global biotechnology industry.

This paper presents a short overview of the biotechnology industry and describes how "science-business" differs from traditional business through the lens of higher education. This approach highlights how traditional implementations of the IPP within business education is insufficient, and discusses the process by which the IPP – context, experience, reflection, action and evaluation – has been developed within the Business of Biotechnology program in the School of Management at the University of San Francisco (USF). The cases developed below demonstrate the IPP as applied to the global biotechnology industry. Our examples include "Organized Religion and the Business of Biotechnology," "Humanist Measures for Success in Bio-Business," and "The Poor and Marginalized." Of note, the IPP is intentionally distinguished from the topic of bioethics, which is intrinsic to all biotechnology. Also discussed below is how the Biotechnology Innovation Expertise Model (BIEM 2.0) is used to demonstrate that disciplines readily present at Jesuit universities can directly support education of value to the global biotechnology industry.

The Global Biotechnology Industry

Perhaps the most important aspect when considering the global biotechnology industry is its dual nature. While its goals are to feed all people, heal all disease, and advance ecological practices, at its core it is a collection of for-profit businesses. As such, it must create a return on investment to sustain itself, while much of the world is incapable of participating in this economic proposition.

We are now at an historic nexus of science and technology. Genes of every living organism can be decoded, analyzed, manipulated, inserted and extracted. Out of this capability has grown the global biotechnology industry, whose imprint on humanity has only begun to be felt. In human terms, biopharmaceuticals are at the heart of precision medicine, offering exact diagnostics and treatments based on a patient's own DNA. On the agricultural front, genetically-engineered drought- and pest-resistant crops are grown in 27 nations, 19 of which are designated as developing countries. While some crops are transformed into alternative fuel, others are foodstuffs and source materials (e.g., cotton). In the manufacturing sector, bio-engineered industrial enzymes continue to replace polluting manufacturing processes, supporting the sustainability of the planet.

In economic terms, the bio-pharmaceutical sector sustained 2012 revenues in the $90 billion range, while bio-fuels comprised $148 billion of the $5 trillion global fuel market. The reach of the agricultural sector (AgBio) can be viewed as the combined output of 420 million acres of genetically-engineered crops planted worldwide. And the economic sector of industrial enzymes reports $3.5 billion in revenues in 2011.[4]

The global biotechnology industry creates many opportunities in which individuals can bring about reflective insight and responsible, creative action, which in turn can broaden the industry's reach to include all humanity. This is the promise of the Ignatian Pedagogical Paradigm.

Is Bio-Business Different?

From an educational standpoint, it is important to ask: Is there a compelling need to address the IPP and the global biotechnology industry, separate and apart from general business? Significant efforts have long infused the IPP into Jesuit business education. Is bio-business so different from any other business? The response is straightforward. First of all, the industry is based on the continuous introduction of cutting-edge science, with a focus on transforming scientific breakthroughs into viable commercial technologies. This is called "science-business," and the risks, the potential impact on lives, the immediate applicability to all humans and all living organisms, and the potential downsides are well-documented.[5]

Unlike other businesses, the science-to-product lifecycle also requires an extraordinary complement of diverse expertise, and successful interaction among the people involved. One depiction of the expertise needed is the BIEM 2.0. Its initial version was published in the *Journal of Commercial Biotechnology*,[6] where it identifies twelve essential expertise categories needed by bioenterprise, only one of which is science. BIEM 2.0 enabled the inclusion of bio-medical devices along with bio-pharmaceuticals, agricultural biotechnology and industrial biotechnology, by adding science/technology in addition to simply science. BIEM 2.0 is depicted in Figure 1.

While describing science-oriented business, many of the disciplines found in BIEM 2.0 are regularly taught at Jesuit institutions of higher learning in non-science disciplines: intellectual property, venture capital, finance, law, marketing, media, ethics and bioethics, information systems, social policy and multi-national expertise. They reach across the university, while independently playing a crucial and dynamic role in the innovative science-to-product lifecycle. With the introduction of ever-newer science and constantly-changing technology, the need for individuals in every discipline to incorporate Ignatian values is paramount.

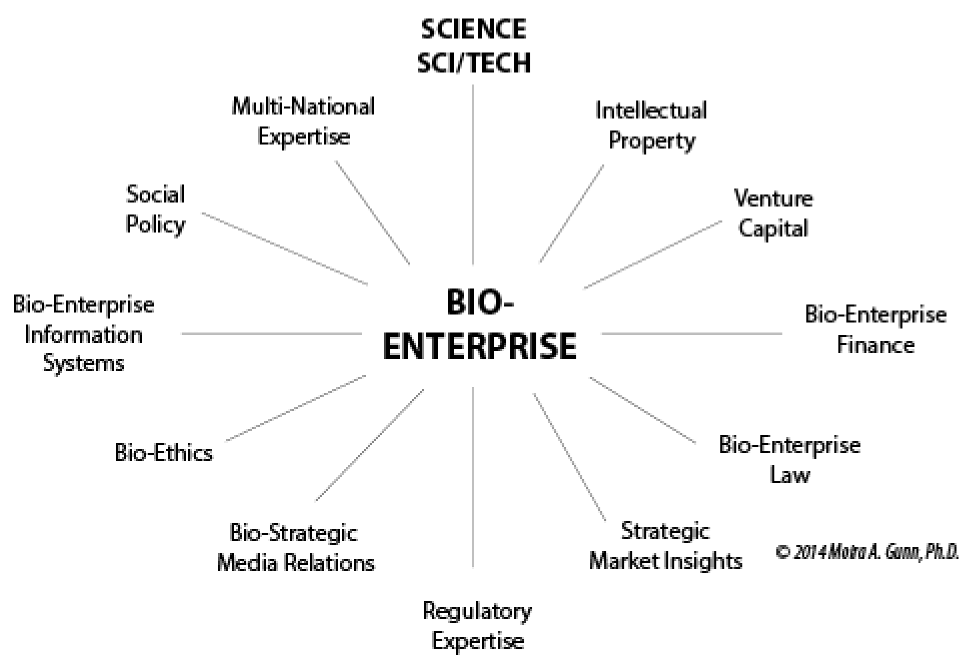

Figure 1: Bioenterprise Innovation Expertise Model (BIEM 2.0)

Embedding the IPP in the Biotechnology Science-to-Product Life Cycle

The Business of Biotechnology program at the University of San Francisco was designed to integrate the BIEM 2.0 disciplines of the biotechnology science-to-product lifecycle, and to engender students across these disciplines to study together, as they will work together in industry. It is comprised of four lecture courses and a complement of one-week global study tours:

- MBA 6561 Local, National and Global Bio-Business
- MBA 6562 The Information of Biotech
- MBA 6563 Legal, Social & Ethical Implications of Biotech
- MBA 6564 Bioentrepreneurship and the San Francisco Bio-cluster (to be scheduled)
- MBA 6797 Biotechnology Global study tours: including London/Oxford/Cambridge, Switzerland, Montreal/Quebec City, Washington, DC, and Sydney, Australia.

These courses draw students from degree programs across the university, including: MBA, JD/MBA, MS/Information Systems, Masters of Public Administration, MS/Healthcare Informatics, and Professional Science Masters/Biotechnology, among others. The multi-discipline nature of bio-business provides a rich opportunity for asking questions of the individual in relation to the biotechnology industry in a relevant, multi-disciplined setting.

The Strategy of IPP in Business of Biotechnology Courses

Whether designed for individuals or groups, the activities and exercises throughout all the courses directly embrace Ignatian goals by incorporating the five elements that make up the IPP: *context, experience, reflection, action,* and *evaluation.* In group exercises, the Context element requires that group members reveal to each other (on a voluntary basis) their individual context and framing experiences, and similarly, all subsequent phases require that dissimilar viewpoints are embraced and respected. Three cases are offered as exemplars of the IPP.

Case #1: Organized Religion and the Business of Biotechnology

The orientation of the world's major religions toward biotechnology is set against a multi-national geographic landscape, wherein products must meet each nation's regulatory environment, while both understanding and respecting the religious profile of its society. The religions studied in the program include Roman Catholicism and other Christian religions, Judaism, Islam, Hinduism, and Buddhism, and any religion or spiritual practice represented by students in the class.

Eliciting comparative religious perspectives with respect to biotechnology can be challenging. No single viewpoint on the whole of biotechnology is offered by any religion; rather, religious positions typically relate to selective, specific biotechnologies and identify positions on particular circumstances of their use. Many religions offer multiple interpretations, depending upon their internal interpretive structures. Roman Catholicism, for example, provides public documents. The most recent positions of Roman Catholicism vis-à-vis the use of biotechnology can be found in the 2008 Vatican *Instruction* Dignitas Personae *on certain Bioethical Questions*[7] and a complement of study reports from the Pontifical Academy of Sciences regarding agricultural biotechnology.[8] These documents describe relevant underlying science and technology using a multi-layered framework for the Church's or the Academy's position and its rationale.

By way of example, *Dignitas Personae* states: "The dignity of a person must be recognized in every human being from conception to natural death … The Church moreover holds that it is ethically unacceptable to dissociate procreation from the integrally personal context of the conjugal act."[9] This confirms the Church's longstanding rejection of *in vitro* fertilization (IVF),[10] which is not itself a genetic biotechnical procedure. Still, the *Dignitas Personae* Instruction recognizes that today a typical precursor to IVF is pre-implantation genetic diagnosis. This genetic test analyzes fertilized embryos created via IVF external to the human body and provides information regarding the biological status of each prior to implantation in the prospective mother. Here the Church further objects, and the many considerations presented include the potential for the "qualitative selection and consequent destruction of embryos" and "treating the human embryo as mere 'laboratory material'."[11] Of note, *Dignitas Personae* is the first instruction regarding biotechnology since the 1988 Vatican Instruction *Donum Vitae*,[12] a time span representing virtually the entire lifetime of the commercial biotechnology industry. At the same time, *Dignitas Personae* is a forward-looking document, anticipating a number of projected biotechnology developments.

While students are required to read the primary source material of *Dignitas Personae,* multi-religion insights are more often found in the peer-reviewed literature and select textbooks. Continuing on the theme of IVF and pre-implantation genetic diagnosis, both individual and multi-religion insights are available. Ari Zivotofsky and Alan Jotokowitz published "A Jewish Response to the Vatican's New Bioethical Guidelines,"[13] and in "Assisted Reproductive Technologies and World Religions: Implications for Couples Therapy,"[14] Jennifer Connor, et al. discuss points of agreement and disagreement across Judaism, Christianity, and Islam, providing independent analyses of Judaism, Roman Catholicism, Protestant Christianity, and Islam, as well. The later paper is oriented to advising couples and considers the implications of generational familial beliefs, cultural perceptions and legal impacts in some geographic areas. In support of projects during the course, students seek out sources in the literature relevant to their focus area.

In a very few topic areas are textbooks available and sufficiently up to date given the emergence and adoption of biotechnology. One current example in the agricultural biotechnology space is *Acceptable Genes? Religious Traditions and Genetically Modified Foods*,[15] published in 2009 and edited by Conrad Brunk and Harold Coward. It provides insights from a series of authors regarding Judaism, Christianity, Islam, Buddhism, Hinduism and indigenous peoples. This is used in contrast to the Pontifical Academy reports,[16] which are supportive of genetically-modified agriculture in the interests of feeding humanity. This book focuses instead on religions wherein dietary laws play a strict role.

The challenge is quite simply that biotechnology – as with all technologies – continues to evolve, while organized religions must respond with due diligence and consideration. In fact, prior positions may be re-evaluated and refined, new positions must anticipate the response to future technologies. Case in point, early stem cell therapies derived source materials from embryonic stem cells, which could not be approved by the Roman Catholic Church. Yet, in *Dignitas Personae*, stem cell therapies were projected to be acceptable if adult stem cells could be used. While sourcing from adult stem cells has not materialized substantively as yet in the industry, there is significant commercial research and development underway, and arguably, stating the potential for acceptability can affect the course of human innovation. Other considerations in *Dignitas Personae* include assessing risk to individuals with each new technology and examining the potential for passing genetic modifications on to progeny.

In-class discussions range from identifying the religious profiles of various countries, to the national acceptance/rejection of genetically-engineered crops/food, to considerations about the individuals with respect to religious and spiritual practice, to students' own experience, actions and reactions.

One specific example used is Living Cell Technologies, a New Zealand/Australian firm which is working on placing insulin-producing cells from pigs inside a nano-material sack embedded beneath the skin. While these sacks have successfully been shown in trials to be effective in producing insulin for sustained periods, it is important to consider that for those of the Muslim and Jewish faiths, consumption of pork is forbidden. Would this technology be considered consumption? Would it be acceptable if certain constraints could be met? How might one address this? Other discussion points with religious implications include: *in vitro* fertilization, pre-implantation embryonic testing, embryonic stem cell research, therapeutic cloning and animal cloning.

Individual assignments require that student select a topic or product relevant to the biotechnology industry. This could reflect a company, a regulatory body, a nation, a law, an advocacy group, etc. Students must then investigate their choice with respect to a candidate organized religion.

As an individual exercise, the following aspects are included:

- *Context:* The individual's own history vis-à-vis organized religion, his/her current religious orientation/affiliation (if any), and history vis-à-vis the candidate religion.
- *Experience:* The student is encouraged to relate his/her own religious life experience to the issue at hand. The student then performs a differential analysis, if the candidate religion is different from his/her own religion of origin.
- *Reflection:* As a part of the experiential process, the student is asked to reveal elements which are bothersome, disingenuous, problematic, incomprehensible, frustrating, etc. regarding the issue. Students are encouraged to interact with those of relevant faiths – both inside and outside of their class, if a religion other than their religion of origin or personal choice was selected.
- *Action:* Students are asked to propose potential actions and solutions. Frequently, these relate to the discipline of their degree program; thus, students are encouraged to interact with those from other disciplines to expand perspectives, enlarge options, review viability, etc.
- *Evaluation:* Students are asked to share their experience of understanding the issue and their attempt to create workable solutions. This includes understanding the basis for false starts, what could and could not be resolved with the actions proposed, and what remains to be addressed.

As a group exercise, adjustments are made to take advantage of a mixed-discipline, potentially mixed-religion group with the capability of creating far more diverse solutions. They quickly dispatch unworkable solutions, given insights from particular disciplines. Group exercises give the students experience in respecting all involved.

Case #2: Humanist Measures for Success in Bio-Business

Traditional business measures fall short when applied to bio-business, especially when the successful use of biotechnology products can save human lives and/or reduce human suffering. One example presented to Business of Biotechnology students is Genomic Health, Inc., a profitable, publicly-traded genetics diagnostics firm (GHDX [NASDAQ]) which specializes in improved diagnostics for breast, colon and prostate cancers. In the case of breast cancer patients where chemotherapy is the recommended standard of care, only four in 100 women who receive chemotherapy actually benefit from the treatment. Most patients and their doctors choose the chemotherapeutic option in the hope that they will be one of the four per cent for whom it will work.

Since its introduction, Genomic Health's Oncotype DX test has provided further analysis of tumors' genetic composition. Is the cancer aggressive? Will it be responsive to chemotherapy, and to which particular chemotherapy drugs?

In a 2012 Canadian decision-impact study, physicians changed their treatment recommendations 30% of the time given the result of the Oncotype DX test. Within those decision changes, 20% of the patients were advised to omit chemotherapy, while 10% were advised to add particular chemotherapy when test results predicted the treatment would be beneficial. Since the test became available, the use of chemotherapy in the United States for these specific conditions has steadily declined, which turn reduces the suffering caused by uninformed treatments.[17]

At the same time, Genomic Health has come under pressure from financial industry analysts to reduce the 20% it feeds back into its budget for further research and development (R&D). A more typical R&D re-investment range might be 5%-9%. Measuring "suffering saved" enables economics to be balanced with service to others, while the company remains financially sound.

Class discussion revolves around attempting to identify other conditions for success, such as alleviating human suffering, reducing impact on families, arguing for long-term goals vs. short-term return, quantifying value in non-economic terms, etc.

Individual assignments require that students select a non-economic, atypical measure for success, then select a candidate company/product to evaluate. These individual exercises include the following aspects:

- *Context:* The individual's own history with respect to this measure and the candidate company/product.
- *Experience:* Students are encouraged to relate in their own words why that measure is important and its impact on people and society external to his experience.
- *Reflection:* As a part of the experiential process, students are asked to describe the impact on individuals and society if this measure was achieved.
- *Action:* Students are asked to propose potential actions and solutions. These solutions may include changes to basic business models, laws, social policy, regulations, etc.
- *Evaluation:* Students are asked to express their experience with this exercise and how they personally felt with the realization that this could be an actual measure of success.

As a group exercise, the experience matches that of Case #1.

Case #3: The Poor and Marginalized

In 2001/2002, Gilead Sciences, Inc. (GILD [NASDAQ]) received approval for its HIV medication Viread in the United States and Europe. Taken once per day orally with a meal, Viread was a breakthrough for patients, as previous medications required multiple pills at varying intervals. With patent protection through 2017/2018, this period is typically used in the pharmaceutical industry to recover investment and establish full profitability. But in 2003, Gilead put into place an access program enabling all African countries and 15 other nations identified by the United Nations as "least-developed" to obtain Viread at non-profit cost. Of note, it was implemented well in advance of recovering the investment made to develop and bring Viread to market, and it was presented as a separate calculation from that endeavor. Two years later, Gilead further reduced the cost of Viread by 37%, to approximately $0.82/day at a time when the full retail price of the drug was approaching $20.00/day.[18]

Today, 4.7 million people in low- and middle-income countries receive Gilead HIV therapies at reduced pricing through a variety of innovative economic programs, including voluntary generic licensing and local business partnering.[19]

Students are asked to consider the premise: If a technology exists that relieves a disease, is it inhumane to deny it to any human?

Individual assignments require that students think inventively about addressing the totality of human needs, while creating and nurturing economically-viable business propositions. They are asked to design programs which serve all humanity from the outset, and they are encouraged to invent new business groundrules. As an individual exercise, the following aspects are included:

- *Context:* The student is asked to pick a product – approved or not yet approved, real or fictitious. The individual is asked to reveal his/her own history with respect to the treatment and/or condition.
- *Experience:* The student is encouraged to explore all the people globally who require the treatment, and their actual condition: socio-economic, environmental, etc. The student is asked to reveal what groups or situations s/he found surprising in this quest.
- *Reflection:* As a part of the experiential process, the student is asked to reveal which people affected him/her the most, and what s/he learned that s/he did not know, and needed to know, or s/he would not have a workable action.
- *Action:* Students are asked to propose potential actions and solutions. These solutions may include changes to basic business models, laws, social policy, regulations, etc. There may be

multiple solutions, or only solutions for some subgroups.
- *Evaluation:* Students are asked to express their experience with this exercise, and to evaluate what solutions were successful and what problems remain to be addressed.

As a group exercise, the experience matches that of Cases #1 and #2.

Bioethics, the IPP, and Curriculum Values

It should be stated that bioethics is a separate and important field, with a larger purview than today's biotechnology industry. Furthermore, ethical challenges are typically not the driver of new action. Through the IPP, an individual can have the vision to improve on an ethical situation, producing a greater human benefit. Aspects of bioethics relevant to the biotechnology industry are included throughout the Business of Biotechnology curriculum on a specific basis, and should not to be confused with the incorporation of the IPP into assignments, the personal journey IPP seeks to engender, or the habit of creative action IPP supports. While bioethical issues can sometimes overlap with IPP-embedded exercises, they are not one and the same. Margaret McLean, the Director of Biotechnology and Health Care Ethics at the Markkula Center for Applied Ethics at Santa Clara University refers to this area of bioethics as "biotech ethics" and provides a more biotechnology industry-relevant framework in what she terms "Reasoning into Biotech Practice."[20] It is essentially this "biotech ethics" framework which is largely utilized throughout the USF curriculum.

Another aspect which relates to this topic is the question of values and IPP practice measurement among adult students. Graduate student practices of reflection over time within a degree program were measured, presented and discussed by Coiro, et al.,[21] with focus on the reflection portion of the IPP and the adult student. This is particularly germane to students in the Business of Biotechnology courses, as they are all post-graduate. Complementary research has begun and is in its formative stages in the Business of Biotechnology Program, measuring student perception of Jesuit values as expressed in USF's mission and values statement and its reflection in individual course content. In some cases, this has been measured on exit, while in others, it is being measured on a differential entry-and-exit basis. This is an extension of the GLAS project, the Gunn-Lorton Attitudinal Survey, which also includes undergraduate testing. This approach of "testing the course" is at its center of focus,[22] and it proves to be a complex, yet important, question.

U.S. Jesuit Universities and Bioenterprise-Relevant Education

Taken together, the capability of the 28 U.S. Jesuit universities to address bioenterprise-relevant education is undeniable. They sustain three medical schools, and six PhD programs in Biology. Fourteen of these universities host law schools, another fourteen offer joint JD/MBA degrees, six offer a Masters in Biology, and all 28 U.S. Jesuit universities have Biology departments. All but one of these universities have a business school.

Specific bioenterprise-relevant education varies with other degree programs in place. In the area of the biopharmaceuticals, these courses may embedded within healthcare management programs. St. Joseph University offers a Pharmaceutical and Healthcare Marketing MBA for Executives, while both Gonzaga University and Loyola University Chicago offer MBAs in Healthcare Management. Marquette University offers a Masters in Healthcare Technology Management.

Health informatics is represented by such programs as St. Joseph's Online Masters in Health Administration with an Informatics Specialization, while Le Moyne College offers a certificate for working professionals in Health Information Systems. The University of San Francisco has commenced a Masters in Health Informatics in online, onsite and hybrid forms originating from the School of Nursing and Health Professions.

Jesuit law schools are participating in the biotechnology field with Santa Clara University's focus on biotechnology law. SCU offers such courses as Assisted Reproduction, Cloning, and Genetic Engineering, as well as a Biotechnology

Law Seminar. SCU's offering is complemented by the Markkula Center for Applied Ethics' focus on bioethics. St. Louis University School of Law offers the course Biotechnology Law and Policy, while USF's School of Law offers courses on Science and the Law, and Biotechnology Law.

In addition to its Business of Biotechnology program described earlier, USF commenced a Professional Science Masters in Biotechnology degree program in its College of Arts & Sciences in 2012, collaborating with the Business of Biotechnology program to achieve the required topical business credits. Creighton University had less success with its Professional Science Masters (PSM) in Bioscience Management. This is due in some part to the fact that Omaha is a challenging geographic area in which to recruit the PSM-required biotechnology internships from local bio-businesses. Still, Creighton has continued with its undergraduate Bioscience Management track in the Marketing and Management bachelors program.

Since 2008, USF has offered a Masters in Information Systems with a concentration in Biotechnology, which incorporated Business of Biotechnology courses. In engineering, Marquette University has a full roster of degrees in the field of Biomedical Engineering – ranging from bachelors to PhD. Fordham University offers a certificate in biomedical informatics.

This overview of Jesuit education in the field of bioentrepreneurship is not meant to be exhaustive, but rather to demonstrate that every Jesuit university has the capability to support many aspects of bio-business, as demonstrated by the BIEM 2.0 model. Such programs can be developed by a roster of interested faculty across schools in the respective universities and can incorporate efforts already underway to develop flexible, cohesive, university-wide bioenterprise-focused programs. Each course and each program can incorporate the IPP successfully in every instance. Also, the success of engendering non-science professional graduate students with significantly increased comfort levels toward the biotechnology industry was measured on successive study tours to global bio-clusters.[23] It is indeed possible to develop an appreciation for and understanding of the global biotechnology industry for those with no formal science training in their undergraduate and graduate university experience.

It should be noted that a complement of non-Jesuit higher education bioentrepreneurship courses and programs have emerged globally in recent years. Dr. Lynn Johnson Langer, a program director at the Johns Hopkins University's Center for Biotechnology Education, cites a selected list of 26 such bioentrepreneurship programs in "Building a Curriculum for Bioentrepreneurs", which was published in *Nature Biotechnology Bioentrepreneur*.[24] Of the 26 programs identified, 19 are located in the United States, while only one is at a Jesuit university (USF). Bioentrepreneurship programs are just now taking shape for good reason – the U.S. biotechnology industry has matured and its employment needs are now on the rise. In this case, employment potential is driving development of academic programs.

Conclusion: The IPP and the Global Imperative of Biotechnology

While biotechnology naturally attracts those who wish to serve others, the industry is problematic as a profitable business proposition. Biotechnology products require astonishing investments over many years, and efforts are continually fraught with the looming specter of failure. At the end of this period, there are only a relatively few years to recover the investment and generate profits. The 2014 report from the Tufts Center for the Study of Drug Development estimates the cost to develop a successful new drug to be $2.6 Billion.[25] Of the some 1,400 drug compounds the report examined, only 7% were approved, 80% were discontinued, and 13% were still actively being pursued. If all the currently active drug candidates succeed, it still means that 4 out of 5 fail. And successful drugs can take 11-15 years to reach approval.[26]

But the rewards of working in the biotechnology industry refuse to be measured by such standards. With success, biotechnology can save lives, reduce suffering, change the world for the better, and lead us all to know ourselves in ways we never previously imagined.

The importance of a Jesuit education is that it goes beyond business fundamentals and hypothetical discussions of the ethical issues involved – it teaches the individual about the importance of context. It is a call to reflect, a requirement to experience, a freedom to create innovative action, and a habit of evaluation. This paper seeks to document both the importance of instilling Ignatian values in the burgeoning biotechnology sector, as well as the ability of Jesuit universities to educate both scientific and non-scientific biotechnology industry professionals.

But the premise is greater than that. The role for Jesuit education in supporting the biotechnology industry is a higher calling: To educate those who will participate in bioenterprise with an appreciation for the world, a respect for life – both individually and collectively, a sense of relevancy to the moment, a penchant for realistic assessment, an inclusionary vision of religion and spirituality, a larger definition of values, a sense of participating in a great human quest for good, an increased sense of self in a changing world, a sensibility to include the poor and marginalized in unprecedented ways, a perception that new rules can be made and new systems built, and a license to act in a larger context.

This is a promise on which Jesuit education can deliver. HJE

Notes

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