UCLA Anderson School of Management

Management 298D/15

ENTREPRENEURIAL PERSPECTIVES ON BIOTECHNOLOGY

Syllabus version 3/25/2020

COVID-19 UPDATE: Given the risk and uncertainty associated with the spread of the novel coronavirus, UCLA has suspended all classroom teaching during spring quarter. Therefore, this course will be delivered remotely via Zoom. Modifications to the prior syllabus are indicated below.

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Class Sessions
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The birth of the biotechnology industry in the late 1970s and 1980s saw the emergence of many entrepreneurial startups. Some, such as Amgen and Genentech, grew to become vertically integrated producers of biologic drugs, following the dominant business model of the established pharmaceutical companies. Today this path has become more difficult, as the typical cost of bringing a new drug to market has grown to exceed $1 billion, and the lead time from discovery to commercialization is normally ten years or more. Indeed, biotech is an outlier among high-technology industries with respect to the cost, risk and

timeframe of product innovation. Reflecting these challenges, the aggregate financial return on investment in the biotech sector has been negative by some estimates.

Rising costs and lead-times limit the potential for new companies to follow the growth pattern of the successful early biotech entrants. Nevertheless, a variety of entrepreneurial opportunities have emerged in recent years. The established biopharmaceutical companies have become almost fully dependent on universities and startup companies for the discovery of new drugs. The vertically integrated model of the major players has broken down, and the landscape of the industry has become more diverse. A large network of firms has arisen to provide development and manufacturing services on a contract basis. These "CDMOs" serve the large, established biopharmaceutical companies as well as many smaller, discovery-based firms that are attempting to move their drugs forward to market. Increasingly, a variety of new organizational forms are showing promise, including virtual biotech companies and technology platform-based firms. Moreover, non-profit foundations are now funding innovative technologies in areas of drug development that fail to attract private funding. Across the sector, a varied set of business models have been evolving to deal with the many challenges of translating basic scientific knowledge into biomedical products that serve human needs.

This course provides perspective on the evolving landscape of biotechnology from the standpoint of new entrepreneurial companies. It focuses on changes and challenges in the industry, as well as opportunities for startups and new entrants. The course is appropriate for MBA students who wish to deepen their understanding of the biotechnology industry and the many entrepreneurial opportunities that the industry provides. The course is also appropriate for graduate students in the life sciences who contemplate possible careers in biotechnology and who seek to deepen their understanding of the relevant business context.

The course provides insights through a range of approaches and materials, including readings, cases, lectures, outside speakers, and class discussion. The course meets once a week in a three-hour session, which will normally be divided into two parts. One part will be case discussion or lecture; the other will be presentation by an outside speaker. Outside speakers include industry entrepreneurs, CEOs, scientists, consultants and other experts.

ASSIGNMENTS AND GRADING

Participation in class discussion is strongly emphasized in this course. Much of the course is devoted to a selection of cases on biotechnology companies. Interaction with fellow students and the instructor are essential for productive learning from the cases. Similarly, active involvement and exchange with our guest speakers are important for you to get the most from this course.

The course has various written assignments to be submitted during the quarter. Some are to be done individually, and others in study groups. In class, we will organize study groups early in the quarter to ensure that science students from South Campus are linked

with Anderson MBAs. Students in this course come with complementary skills, and it is important that you learn from each other. (If you are a student for whom coordination with a study group is logistically very difficult, the case write-ups can also be submitted as individual work.)

The student group assignments include three short case write-ups, and a final project. The final project is an in-class presentation that pursues one of the course topics (your choice) in greater depth.

The individual assignments include web postings on a company or issue of interest to you, and three one-page memos. (You choose three memos from the larger set of options listed in this syllabus.)

Final grades in this course will be made up of the following components:

25% - class participation;
25% - one-page memos and web posting (3 memos, individual);
25% - written analysis of three assigned cases (3 cases, group or individual);
25% - final presentation investigating a course topic in greater depth (group).

Student final grade distributions will be determined according to UCLA Anderson guidelines:

- A- or above: No more than 50% of the class
- B+ or below: At least 50% of the class

- **COVID-19 UPDATE**: In light of the difficulties faced by students, this grade distribution may be relaxed during spring quarter.

NOTE: There will be no final exam in this course.

Class Participation

This course is largely case and speaker-based, and its success depends heavily on the quality of class discussion. To prepare for class, you must read the materials *and* think about the case preparation questions in advance. In assigning grades to class discussion I will focus primarily on the *quality* of your comments and interaction with the class. (It takes some *quantity* of participation, however, for me to make that evaluation. If you find class participation difficult, please make an appointment to see me early in the quarter, as there are ways that I can make the process easier for you.)

In general, the best class comments:

- Make or raise issues that are relevant to the current focus of the class
- Show curiosity and a willingness to experiment
- Use data or examples to support conclusions
- Take into consideration the ideas offered by others

- Offer support for arguments
- Help others feel safe about participating

COVID-19 UPDATE: Class sessions will take place at the originally scheduled time via Zoom. (A Zoom link for each session will be posted on CCLE. The norm for student participation will be to have video on, microphone off.) Guest speakers will present materials and engage in Q&A via Zoom. Case discussions will be adapted to the online format.

Given the limitations of the online format with a large class of students, much of class participation and interaction will take place through use of the discussion forum on CCLE. (See "Activities/Resources: Discussion Forum" on the CCLE web site.) While I will post a set of discussion forum questions, students are invited to post additional questions and respond to all existing ones. Attributes of a good discussion post include the following:

- Timely
- Well written
- On message
- Generous and respectful
- Stimulate thinking
- Grounded in evidence
- Encourage others to provide evidence
- Moves the class forward

In addition to the use of the discussion forum for interactive discussion, the "Questionsly" forum (see "Course apps: Questionsly" on CCLE) is available to ask specific questions relating to any issues in the course. Questions posed on Questionsly can be directed to the instructor, the TAs, or the class in general.

You are welcome to come to my office hours any time during the quarter to discuss your class participation.

COVID-19 UPDATE: Office hours will be held virtually. The timing and frequency of office hours will be determined based upon needs expressed by students. I will hold one hour or more of virtual office hours each week.

Case Write-ups

There are three brief case write-ups to be handed in. The first, due in Week 2, is on the Diabetogen case. The second, on the Nucleon case, is in Week 4, and the third, on the Abgenix case, is in Week 8. The questions to be addressed in these write-ups are indicated under "GROUP WRITTEN ASSIGNMENT" in the syllabus.

The case write-ups are to be done in study groups, with one paper handed in for the group. (Students can do these write-ups individually if group coordination is difficult.)

The case write-ups are short memos whose text should not exceed two pages. You may, however, attach additional exhibits.

> **COVID-19 UPDATE**: The TAs will endeavor to organize study groups during the first week of class. Normally the optimal group size is four to five students; however, smaller groups are acceptable, and all group assignments can be done on an individual basis if preferred. If you would like to work in a group with specific students, please send an email to the TAs prior to April 1. It is essential that PhD students from South Campus be assigned to groups with MBA students. Group requests will be modified to ensure such pairing of MBA and PhD students. I reserve the right to reshuffle groups as needed as the course progresses.
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> Given the impediments to normal case discussion that exist in the online format, I will select groups with diverse points of view on the assignments to present their analysis in class. To facilitate this selection, all group assignments will be DUE PRIOR TO 8AM ON THE DAY OF CLASS.

Web Discussion Board Postings

Early in the quarter, I will demonstrate the operation of the web-based discussion board. In week five, you are asked to post on the board regarding a specific company or issue of your own choosing. This posting should be done on an individual basis. It should raise an issue of interest to you that, hopefully, will also be of broader interest to other members of the class. You are welcome to link your post to an outside article, web site, or other information.

You are also required to make at least one additional post on the discussion board. You can post on a second company or issue, or make a comment on another student's post. Ideally, a set of web-based discussions will emerge in the latter half of the course.

> **COVID-19 UPDATE**: Given the move to online format, the discussion forum takes on a central role in the course, as noted above. We will start the forum early in the quarter, prior to week five.

One-Page Memos (OPMs)

During the quarter, you are required to submit three brief, one-page memos. There are four possible OPMs listed in the syllabus.

I view these memos as similar to problem sets. The grading system will follow the common scheme where most papers receive "check", with a small proportion receiving "check-plus".

These OPM memos should be uploaded to the appropriate drop box on the course website. Submissions should be made prior to the deadline indicated for each memo.

(Usually, the deadlines are set to allow me to draw information from your submission for discussion in class.)

> **COVID-19 UPDATE**: Given the impediments to normal class discussion and interaction that exist in the online format, I will select authors of OPMs with diverse points of view to present their analysis in class. To facilitate this selection, all OPMs will be DUE PRIOR TO 8AM ON THE DAY OF CLASS.

Final Group Presentation

The final presentations allow you to develop your interest in an issue relating to the course material in greater depth. The presentations will be scheduled during the final class sessions. In addition to the class presentation, your group should submit a hard copy of your PowerPoint slides (plus any related analysis or background materials as an optional supplement).

For your final presentation, you are welcome to focus on any topic related to the course. You should take a point of view or give a recommendation for a company or for public policy. Presentations that merely present factual material tend to fall flat. More details on presentation logistics and requirements are listed on page 12 under Class 10.

If you have questions about your final presentation, you are welcome to make an appointment to meet in my office hours. Although not required, I suggest that you send me a short email by mid-May to get your topic approved.

> **COVID-19 UPDATE**: Given the move to online format, you have the option of recording your group presentation in advance, or presenting it live. In either case there will be a live session scheduled for Q&A. The final presentations will be scheduled during weeks 10 and 11, but with the shift to online format, they need not take place during the regular class time.
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> You are welcome to reconstitute groups for the final presentation. (Your group for the final presentation could be identical to your study group for the case write-ups, or it could be different. I expect substantial shuffling of groups based on interest in final presentation topics.) To prepare a presentation without the ability to meet together in person obviously has challenges, but on the positive side, you will be developing an important skill that will be vital for most professionals in the future.

COURSE MATERIALS

Specific readings and case materials are listed under "course topics and class sessions" below. Most of these are available in an E-course packet available for purchase from Redshelf: https://ucla.redshelf.com/book/1537896
(You will need to create an account unless you have already used this site.)

In addition to the case packet, the following required book is assigned (in its entirety):

Gary S. Pisano, *Science Business: the Promise, the Reality and the Future of Biotech*, Harvard Business School Press, 2006. (Hereafter, PISANO.) It is available for purchase from Amazon and the UCLA bookstore.

For those who are seeking a guide to the science behind the biopharmaceutical industry, I recommend:

The Biotech Primer: An Insider's Guide to the Science Driving the Biopharma Industry available for purchase on Amazon ($23).

TOPICS AND CLASS SESSIONS

Class 1 (3/30). Course Overview / Biotech Industry Business Models

This session sets the stage for the course. The first part of class will be in lecture/discussion mode, covering the following topics: history of the pharmaceutical sector; the emergence of biotechnology; the regulatory environment; unique characteristics and challenges of the biotech industry; the evolving structure of the industry; alternative business models; and the role of entrepreneurial firms.

The second part of class begins to explore the pros and cons of alternative business models for biotechnology companies. The case on MorphoSys describes a company that began with a technology platform licensing model but has been moving to an integrated model, in which it develops its own pipeline of proprietary drugs.

Read: PISANO, Chapters 1, 5 and 6.
Note: It is not required that you do this reading prior to this initial class session.

Case: MorphoSys AG: The Evolution of a Biotechnology Business Model

Study Questions:

1. What do you see as the most salient advantage and disadvantage of the hybrid business model pursued by MorphoSys?
2. Do you agree with the company's decision to move from a platform technology/licensor model to one where MorphoSys develops its own proprietary drugs?
3. If MorphoSys attempts to develop its own proprietary drugs, to what extent should it build the necessary capabilities internally versus contracting out?
4. How should the company manage the risk of such a transition?

Class 2 (4/6). Business Valuation / Regulatory Environment

The Diabetogen case focuses on biotech company valuation. A group written assignment is due before the start of class. In the second part of class, our guest speaker will provide a broad overview of the regulatory environment of the bio-pharma industry.

Read: Note on Valuing a Biotech Company (Ivey note)

Read: PISANO, chapters 2, 3 and 4.

Case: **Diabetogen**

Study Questions:

1. How much is Diabetogen worth?
2. How should ownership be distributed among the stakeholders?

GROUP WRITTEN ASSIGNMENT: Which of the various valuation methods described in the Diabetogen case do you find most valid? Which do you find least valid? What is your best estimate of Diabetogen's value?

Guest Speaker: **Eunjoo Pacifici**, Pharm.D., Ph.D., Associate Director of Graduate Programs, International Center for Regulatory Science; Assistant Professor of Clinical Pharmacy, USC School of Pharmacy.

Class 3 (4/13). IP Strategies in the Biotech Sector

The case on Amgen's Epogen focuses on a critical patent battle early in the history of the biotech industry. Additional optional readings describe the industry's more recent evolution with respect to intellectual property. Our speakers in the second part of class will discuss current IP issues in the biotech sector and how Amgen acquires technology through licensing, partnerships and corporate acquisitions today.

Case: **Amgen Inc.'s Epogen – Commercializing the First Biotech Blockbuster Drug**

Study Questions:

1. Evaluate Amgen's patenting strategy. What are its strengths and weaknesses?
2. What are Amgen's options in dealing with GI? How do you assess them?
3. Should Rathmann execute the royalty-free cross-license?

OPM #1: Should Rathmann execute the royalty-free cross-license? Why or why not?

Read: PISANO, Chapter 7.

Jacob S Sherkow, "Protecting products versus platforms," *Nature Biotechnology*, 2016 (download).

Optional Readings:

"The changing life science patent landscape" *Nature Biotechnology*, March 2016. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2789262

The CRISPR-Cas9 Quarrel (HBS 9-817-020)

Guest Speakers:

Ryan Abbott, MD, JD, MTOM, is Professor of Law and Health Sciences at the University of Surrey School of Law and Adjunct Assistant Professor of Medicine at the

David Geffen School of Medicine at UCLA. He has published widely on issues associated with law and technology, health law, and intellectual property.

Rachna Khosla, MBA, is Vice President in Business Development at Amgen. She leads a team that is responsible for corporate development, strategic collaborations, M&A and licensing/out-licensing activities. To prepare for her talk, read:

Note on Biotech Business Development (HBS note)

Class 4 (4/20). Integration versus Contracting: Decisions about Manufacturing

The decision to manufacture in-house versus outsource is highly debated in both startups and mature companies. In the first part of class we will discuss such a choice facing an early biotech industry entrant. Our speaker in the second part of class has extensive expertise in biotech manufacturing at Amgen, Sanofi and Kite Pharma, where integrated manufacturing represents a key capability in the emerging cell therapy space.

Read: PISANO, Chapter 8

Case: **Nucleon, Inc.**

Study Questions:

1. What are your recommendations regarding the manufacturing of CRP-1 for Phase I and Phase II clinical trials? What are your recommendations regarding manufacturing for Phase III clinical trials and commercialization?
2. How would you justify your recommendation to would-be investors in the company?
3. What should this company look like in 10 years? To what extent should it integrate into manufacturing and other areas?

GROUP WRITTEN ASSIGNMENT: Write a memo to Robert Moore, with recommendations regarding the manufacturing of CRP-1, answering Question 1 above. Your memo should also briefly address Questions 2 and 3. (Your memo should be 2 to 3 pages of text, with optional additional exhibits.)

Guest Speaker: **Jian Irish**, PhD, MBA (Anderson EMBA 2002), is Global Head of Manufacturing at Kite Pharma. She was previously Global Head of Contract Manufacturing and General Manager of Japan Asia Pacific Supply Chain at Amgen. At Sanofi, she oversaw the strategy and execution of the biologics supply chain and technical transfer processes.

Class 5 (4/27). The Role of Universities: Spin Outs and Technology Transfer

Most biotech IP today begins in universities, and the first part of class will consider how technology flows from universities to biotech startups and industry. In the second part of class we will hear from a UCLA Anderson graduate who has served as CEO of several successful biotech companies.

Guest Speaker: **Mark A. Wisniewski**, MS, MBA (Anderson 1996), is Senior Director, Biopharmaceuticals, UCLA Technology Development Group. He is responsible for the life science and biopharma intellectual property developed at UCLA, including managing licensing and marketing staff, financial management of the portfolio and outreach to inventors and industry.

Read: "Technology transfer: The leap to industry," Nature 533, S13–S15, May 5, 2016.

Video: **Big Thinkers - Robert Langer [Biomedical Engineer]**

> Bob Langer of MIT is a widely recognized researcher in biotechnology, especially in the fields of drug delivery systems and tissue engineering. He holds over 1,350 granted or pending patents and has founded more than 30 companies. Langer is one of the 10 most cited individuals in history, according to Google Scholar.

OPM #2: Do you think Bob Langer would have been as successful in spinning out innovative companies if he had been on the faculty at UCLA (rather than MIT)? Why or why not? (Early in his career, Langer seriously considered moving to UCLA.)

Guest Speaker: **Bob Baltera**, MS, MBA (Anderson 1996) is CEO of Cirius Therapeutics. Prior to joining Cirius, he co-founded Hawkeye Therapeutics, a company focused on in-licensing and developing high-quality assets from pharmaceutical companies. He also served as CEO of Laguna Pharmaceuticals and CEO of Amira Pharmaceuticals until its $475 million acquisition by Bristol-Myers Squibb in 2011. Prior to his tenure at Amira, Baltera held various senior management positions over 17 years at Amgen.

WEB DISCUSSION BOARD POSTING: In the "Discussion Forum" section on CCLE, submit a post describing a specific company or issue of your own choosing. Discuss how your example relates to one or more topics in the course. You are welcome to link to an outside article, web site, or other information. Feel free to comment on posts submitted by others; ideally, several interactive discussion threads will emerge from these posts.

Class 6 (5/4). Venture Funding

Video: Andrew Lo: Can Financial Engineering Cure Cancer?
https://www.youtube.com/watch?v=xu86bYKVmRE

Read: Rare Disease Fund Act of 2015
Rare Disease Fund FAQ

Andrew Lo and Gary Pisano, **"**Lessons from Hollywood: A New Approach to Funding R&D," *Sloan Management Review*, Winter 2016. (In course reader.)

OPM #3: Critique Andrew Lo's Megafund concept. What are its major weaknesses? Why has it been so hard to get such a fund started?

Case: **MedImmune Ventures** (HBS 9-814-023)

Study Questions:

1. What function should corporate venture capital (CVC) perform for its parent company?
2. What is your assessment of MedImmune Ventures?
3. What should MedImmune Ventures do with regards to NeuProtect?

Guest Speaker: **Sean Harper**, MD, is Founding Managing Director of Westlake Village BioPartners. Previously he held various leadership positions at Amgen and most recently was Amgen's head of R&D. Time Magazine has named him as one of the 50 most influential people in healthcare.

To prepare for Sean Harper's talk, watch his presentation at the Yale University Innovation Summit.

Class 7 (5/11). Can biotech thrive in Los Angeles?

With the notable exception of Amgen (located just beyond LA, in Ventura County), Los Angeles lags far behind the Bay Area, Boston, and San Diego in the presence and growth of biotech companies. This situation persists despite the presence of major research universities in southern California, including UCLA, Caltech and USC. Yet changes in the past few years suggest that Los Angeles could emerge as a major biotech hub. Is it possible for entrepreneurial biotech to thrive in the LA region? If so, what needs to be done to support it? What lessons does the literature on technology clusters and Silicon Valley provide for biotech in LA?

Read:

Steven Casper, 2009. "The Marketplace for Ideas: Can Los Angeles Build a Successful Biotechnology Cluster?" (download)

Steven Casper, 2012. "The University of California and the Evolution of the Biotechnology Industry in San Diego and the San Francisco Bay Area" (download)

"Building The Biotech City: Is Los Angeles The Go-To Destination For Tomorrow's Drug Innovations?" (download)

Boston Consulting Group, 2018. "Stars Aligning: How Southern California Could Be the Next Great Tech Ecosystem." (download) (Note that this reading relates to tech in general, not biotech in particular.)

OPM #4: In your view, what are the three greatest hurdles to developing a strong biotech cluster in LA?

Panel of Experts:

Steven Casper, PhD, is Henry E. Riggs Professor of Management and Dean of the Henry E. Riggs School of Applied Life Sciences in the Keck Graduate Institute in Claremont, California. His is the author of the required readings for today's class session.

Kenneth Schultz, MD, is Chairman and CEO of Trethera, an LA-based biotech startup that is commercializing novel cancer therapies originating at UCLA. He previously held senior positions at Halozyme Therapeutics, Medtronic, and McKinsey & Company.

Susan Windham-Bannister, PhD, is Chief Strategy Advisor of BioscienceLA, whose mission is to ensure that Los Angeles has a collaborative, well-coalesced ecosystem that encompasses all aspects of the Southern California life sciences cluster. Previously, she served as the founding President and CEO of the Massachusetts Life Sciences Center from July 2008-May 2015, overseeing a $1-billion investment to accelerate the pace of growth in pharmaceuticals, biotechnology, medical devices, medical diagnostics and bioinformatics in the greater Boston area.

Other speakers, **TBA**

Class 8 (5/18). Non-Profit Models for Biotech

Read: PISANO, Chapter 9

View: CHDI Foundation (Huntington's disease) website

Myelin Repair Foundation (MRF): video1 video2 video3

ALS Therapy Development Institute

Guest Speakers:

Susan Hershenson, PhD., Deputy Director, Chemistry, Manufacturing and Controls, The Bill and Melinda Gates Foundation; formerly, Vice President of Pharmaceutical and Device Development, Genentech; Vice President of Pharmaceutics, Amgen.

Robert Pacifici, Ph.D., Chief Scientific Officer, CHDI Foundation.

Case: **Abgenix and the XenoMouse**
(Note: this concluding case relates to several themes we have considered in the course.)

Study Questions:

1. Does Pharmacol or BioPart represent a better way to go for Abgenix? Why?
2. What factors would you focus on in choosing a partner? Which of these factors are most important? Why?
3. What should Scott Greer do?
   - Go it alone through the end of Phase II trials?
   - Sign with Pharmacol?
   - Sign with BioPart?
   - Something else?
4. What are the major risks you see in your decision? How can these be managed?

GROUP WRITTEN ASSIGNMENT: Answer question #3 above for the Abgenix case. (Your write-up should be 2 to 3 pages of text, with optional additional exhibits.)

Class 9 (6/1). Drugs vs. Devices

Guest Speaker: **Martin Burns**, MBA (Anderson '07), CEO, Bruin Biometrics.

Bruin Biometrics, a spin-out from UCLA, has successfully commercialized a hand-held scanner to identify tissue damage. In this session we will compare the challenges of medical device development versus those of developing and commercializing a new drug.

Student presentations will also be scheduled in this class session.

Class 10 (6/8). Student Presentations

Each group will have a total of 18 minutes for the slide presentation and subsequent Q&A. I recommend that you prepare a 10-minute presentation which will allow eight

minutes of Q&A. However, a presentation of up to 12 minutes is OK. (I strongly suggest that you practice your presentation in advance to make sure it will not run over time. Given that all group members will receive the same grade, there is no need for everyone to speak during the slide presentation.) This 18-minute format will allow 10 groups to present within the 3-7 PM window on June 5, with time for a few short breaks.

At the conclusion of your presentation I will normally ask the first question(s) and then open up to questions from the class. Eighteen minutes after the start of your presentation my cell phone will buzz loudly; we will need to quickly finish all discussion and move on to the next group.

If possible, please email your presentation slides to me in advance of the session, and put your Group # in the title. This will allow me to load your presentation onto my laptop prior to class, thereby minimizing the changeover time. Please bring four paper copies of your slides to class, and give them to me prior to the start of your presentation.