

AC 2010-220: BUSINESS BASICS FOR ENGINEERS AND SCIENTISTS: A CASE STUDY ON A NEW GRADUATE COURSE

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ABSTRACT

One of the common complaints of those teaching entrepreneurship courses is that non-business students simply do not have the background in accounting, finance, leadership, organizational behavior, and marketing to benefit from the courses at an appropriate level of depth. As a result, those professors have to teach those topics at some level of detail, which cuts into their instructional time on the key elements of the course. On the opposite side, many engineering and science professors complain that they would like their MS and PhD students to learn more about business, but there is not enough room in the program to take a plethora of business courses. In both cases, the faculty members want students to have a single course they can take that will provide the basics of business. Yet, as we found, such a course is rare. What no one has disputed is the richness of knowledge, approaches, and ideas when engineering, science, and business students are combined in the classroom. With that in mind, we created a new course, Business Basics for Engineers and Scientists, that serves to provide those basic skills engineering and science professors want for their graduate students, and prepares those who wish to take further business or entrepreneurship courses to undertake work at a higher level.

Business Basics for Engineers and Scientists is a new graduate course developed to address the problem of differing knowledge levels and the problem of multiple background courses. **It is not an entrepreneurship course**, so entrepreneurship texts were avoided, but it is a course that engineering and science graduate students can learn from to help prepare them for entrepreneurship courses or for more general business understanding. Through a combination of practical books, articles, notes, cases, and guest speakers, the course introduces students to important theory and practice in three primary areas: organization and leadership, marketing, and accounting and finance. The paper not only describes the construction of the syllabus, but the lessons learned from delivering the initial offering of the course and expectations for changing it going forward.

Background

A strategic initiative of the entrepreneurship program at Worcester Polytechnic Institute (WPI) is the education of students and business practitioners in technology commercialization. For us, that may be licensing technology to existing organizations, whether large or small, or to start-ups, whether internal or external to WPI. As one way to deliver on this, we created a four course graduate certificate program in Innovation Commercialization and Entrepreneurship, referred to as ICE. The component courses are Business Basics for Engineers and Scientists; Technology Commercialization Theory, Practice, and Strategy; Technology Commercialization Project; and an entrepreneurship elective, most likely Entrepreneurial Selling. This paper walks the reader through the development and delivery of the first course, Business Basics for Engineers and Scientists.

Through fifteen years of engagement in entrepreneurship with engineers and scientists at WPI, and 13 years at two other institutions, the author found three key knowledge deficiencies – behavioral and leadership, customer orientation and marketing, and finance and accounting. While other gaps exist, virtually every engineer and scientist we encounter, whether student or professional (including faculty members), suffers these deficiencies. Therefore, we recognized the need to provide education in these areas to engineers and scientists. At the same time we recognized that these students did not have the time to take complete courses in these areas as MBA students would. Thus it was important to create a new course that delivered the basics in these content areas.

Clearly the first challenge was to determine the specific content and develop a syllabus. To help with that an extensive search was conducted to identify textbooks that were on topic. The result was disappointing; not a single book was found that addressed the topics in enough depth, and with enough sophistication, to warrant adoption at the graduate level. (The best text found was Lowell Ackerman, Business Basics for Veterinarians, New York: ASJA Press, 2002, but a quick poll of engineering and science graduate students confirmed my assessment that the book was far too specific to veterinarians.) Quickly, then, the focus changed to finding other books that could accomplish the same objective. That approach, too, was rejected for cost reasons. We saw no reason to ask students to purchase books that cost over \$100 each in all three areas when they may be covering no more than a third of the material, if that. Ultimately we adopted three books: John A. Tracy, How to Read a Financial Report (7e), Hoboken NJ: John Wiley & Sons, 2009; Jae K. Shim, Joel G. Siegel, and Abraham J. Simon, The Vest-Pocket MBA (3e), New York: Penguin Group (USA), 2004; and Steven Silbiger, The Ten Day MBA (3e), New York: Harper Collins, 2005. Tracy's book was intended to be the primary text for the accounting and finance area, while the two MBA books were intended primarily for background reading and reference. Each was different, with The Vest-Pocket MBA being more like a vocabulary and definitions book, and The Ten Day MBA being more of a narrative explanation of a limited number of important concepts. Additionally, it was decided that we would use a variety of readings and cases from Harvard Business School Publishing (HBSP), Darden Case Publishing, and Ivey Case Publishing, as well as readings that were available electronically through the WPI Library. For the HBSP materials, a course folder was set up on that company's educators website and students were able to go in and download the materials using their credit card for payment. For the Darden and Ivey materials, and the HBSP test materials, I ordered and paid for the materials and passed them out to students.

Despite the best of intentions, the full outline was not developed when the course started. Instead, some topics were roughed in for all three areas, then the Organizational and Leadership area was fleshed out. The other areas were fleshed out on the fly.

The initial outline in the Organizational and Leadership area started with an overview of leadership theories and how they are practiced. Quickly, however, other areas of need were recognized. First, it was likely that students had no understanding of the purpose of an organization (it is **not** to make a profit, as accountants and accounting faculty members would have you believe), thus that needed to be an early topic. Second, the concepts of vision and mission, which are critical activities of leaders, were missing, but were deemed to be critical early topics. Third, we believed that students needed to understand organization models so they

could see how they would structure an organization from launch, but also how it might change over time as the organization matures. Finally, human resource management topics, such as hiring and performance evaluation, were deemed important. Some would argue that businesses do not fail on these points, but, in fact, a long history of literature demonstrates that most business failures are failures of management, not technology, not product or service, and not financial. Instead it is failures in the above management areas that lead to failures in the other areas.

The initial outline in the Customer Orientation and Marketing area did not change as much. In the initial class period on marketing, we focused on developing a basic understanding of the function. From working with engineers, many do not understand about doing research on markets and customers, thus that became the next class period. In the third marketing class period we focused on branding and how that adds value to an organization. In the final marketing class period we focused on globalization to help students understand that what works in one market does not necessarily work in another market, and there are other issues that need to be addressed, as well.

The initial outline in the Accounting and Finance area was aggressive. In addition to teaching students about income statements, balance sheets, and cash flow statements, along with the interconnections, we planned to include both horizontal and vertical analysis and budgeting. Managing cash flow and various methods of financing and the time value of money were part of the outline, as well.

How It Played Out

Clearly what one plans is not always how things play out. This section of the paper will review what worked well, what did not work well and should be changed, what was omitted and should have been included, and what was included and should be eliminated.

We made the decision not to promote the course actively in the first offering, thinking that a small enrollment while we tested the structure and content would be most appropriate. We believed that the course would populate, probably in the range of 8-10 students, in both the engineering and science disciplines. In fact, only five engineering students enrolled in the course (1 MS Chemical Engineering, 3 MS Civil Engineering, 1 PhD Manufacturing Engineering), and one of them, the doctoral student, dropped out after the first week. Additionally, only one of the remaining students had any professional work experience, and the other three were essentially undergraduate students as they were in the combined BS/MS program in their disciplines. While we cannot control the amount of experience students have, we recognize the folly of not engaging in more active promotion that would have yielded stronger enrollments.

With a heavy orientation toward case analysis and discussion, the relative youth of the students was somewhat of a drawback, as was the small enrollment. Without professional work experience, they had limited opportunity to offer grounded comments that might challenge or support theory. Additionally, there was some initial reluctance to engage in discussion, despite spending part of the initial class period on an explanation of how to analyze and discuss a case study. Stronger emphasis on that area, beyond the reading and the partial class period devoted to

cases analysis and discussion, is needed going forward. Additionally, an example case analysis and presentation will be provided – live – as a model for the students.

The organization of the course followed the way topics were sequenced above: behavioral, marketing, and accounting. That was not an easy decision. Initially the thinking was that we should start with the accounting and finance area, followed by the other topics in any order. However, the accounting and finance area was moved to the end of the course. The rationale for this move was that as quantitative topics, engineering students would take more readily to those topics than they would to behavioral and marketing topics, and we should save the “easy” topics until the end.

As the course launched, it became clear in the first class period that the most common idea about the purpose of a business was that organizations exist to make a profit for shareholders. This is the accounting perspective, but it is narrow and misses the customer and market orientation that is needed in all organizations, especially start-ups! Thus, on the fly we pulled in work by Drucker, who said that the purpose of a business is to identify and meet a customer need; if one does that efficiently and effectively, profits will come and the continuation of the enterprise is ensured. This raised another question: why are the views of the purpose of a business different? Again, on the fly we addressed the issue of paradigmatic differences and in the next class period shared a video on the power of paradigms. Student had no idea that leaders of organizations could decide how they want to structure the organization and that different structures meet different needs. Similarly, they had never thought about hiring people from the employer’s perspective, only from the prospective employee’s perspective. Yet having learned about determining employment needs and interviewing techniques, they felt better prepared for the employment interviews they expected to have later in the semester.

The customer orientation and marketing section went largely as expected, although we discovered that there was not as much time to teach some of the quantitative marketing concepts as planned. That was largely limited to a means for determining potential and realistic market sizes. On the flip side, the students quickly grasped the importance of voice of the customer and meeting customer needs versus selling features, and they aggressively pushed that concept in the case studies, which was more than a minor breakthrough given our past experience with engineers and scientists. What was disappointing in this section was the globalization module. I made an effort to find a strong practitioner piece on the difference between firms that start and then go global versus born global firms, to no avail.

Accounting and finance was a disappointment. This section of the course felt rushed. Furthermore, using only readings and case studies left us feeling like the students did not have a deep enough understanding of the material. That said, the students demonstrated on their final examination that they could conduct horizontal and vertical analyses of financial statements, and, with only a few minor mistakes, create a cash flow statement, which is a positive outcome. In the next iteration of the course it is likely we shall devote more time, possibly as much as half of the course, to this material. Part of that time will be spent on providing the students with an abbreviated business plan for an opportunity that is not too complex and require them to develop financial statements from scratch. Another part of the time will be devoted to financing needs

and opportunities, which were given very brief attention during the course. We shall also incorporate some problem sets into the assignments.

Overall Assessment

While the four students felt as if they benefitted from the course, they had some suggestions. Of the three books, only the Tracy book and The Vest Pocket MBA provided meaningful value. Tracy was a key part of the course and students recognized that. They noted that the book is dry, but informative and a great reference resource. Students used The Vest Pocket MBA to learn the lingo of business and the meanings of those terms, then used them in their case discussions. This was important because understanding the jargon of any discipline, and how to use it properly, tells others that the person fits and is one of them. The Ten Day MBA provided considerably less value. Students felt that there was not enough detail in the narratives and that it could be jettisoned.

As one will see in the appendix, numerous readings and cases were assigned, as well. Some of the readings were intended to provide background without discussing them in class, while others were the basis of discussion. All of the articles were expected to be used by the students in analyzing, understanding, and discussing the cases. One comment from the students was that they felt that readings should not be assigned unless they were to be discussed in class. My interpretation was that this was a result of their relative immaturity compared to other graduate students I have worked with (remember, they are essentially undergraduate students), and their inexperience with case studies. This is something I will need to manage more carefully and may be built into the demonstration case analysis and presentation, although that will require advance work by the students, which is not the norm here. Despite their inexperience with the case method, the students responded well to it. I saw them advance from relatively superficial analyses to increasingly more sophisticated analyses. Important details that they missed early in the course were consistently brought out in later cases.

One of the things that students said they particularly enjoyed was the way real life experiences were woven into discussions of readings and cases. Clearly I called on my own experiences as an employee, manager, and owner. I also called on the students to try to relate some of the theories and tools to their own experiences in summer jobs and student organizations to help them ground the concepts.

From my perspective, changing the order in which material is covered, strengthening some areas and reducing other areas, will strengthen the overall course. Far more attention will be given to accounting and finance, possibly devoting half the course to that area. Problem sets will be required, and other cases will be selected that have a strong problem orientation. The challenge will be determining the materials to cut, or how to combine materials into one module. Another important change will be promotion of the course. Clearly promoting the course is needed to build the enrollments, and that process has already started.

All-in-all the course seemed to accomplish its objective of providing a basic understanding of some important business concepts to the enrolled students. The students evaluated the course positively (4.65/5.0), and engineering and science professors with whom we have discussed the

course agree that it is an important addition to the course schedule. We shall be offering it again, but the proof will be in the enrollment.

For a complete copy of the syllabus, please send an email message to macb@wpi.edu.

Appendix: Course Topics and Readings

Ethics and Values

TDMBA: Ethics (including SOX), pp 60-70

VP MBA: Labor Laws, Torts, White Collar Crime, and Ethics, pp 160-168; SOX, pp 193-202

Wicks, Andrew C. "A Note on Ethical Decision-Making" Darden Business Publishing (handout)

Case: Ethics of Offshoring: Novo Nordisk and Clinical Trials in Emerging Economies, Klaus Meyer

Raynor, Michael, "That Vision Thing: Do We Need It?"

http://www.sciencedirect.com/science?_ob=MImg&_imagekey=B6V6K-46BJR7K-4-1&_cdi=5817&_user=74021&_orig=search&_coverDate=06%2F30%2F1998&_sk=999689996&_view=c&_wchp=dGLzVtb-zSkWb&_md5=032142fdb67601ef4ea36ff0e9407faa&_ie=/sdarticle.pdf

Lucas, James R. "Anatomy of a Vision Statement"

<http://web.ebscohost.com/ehost/pdf?vid=6&hid=108&sid=f48c65b6-de94-430b-a830-e8c395f2cf49%40sessionmgr111>

Quigley, Joseph V. "Vision: How Leaders Develop It, Share It, and Sustain It."

<http://web.ebscohost.com/ehost/pdf?vid=7&hid=108&sid=f48c65b6-de94-430b-a830-e8c395f2cf49%40sessionmgr111>

Effective Leadership

TDMBA: Leadership, pp. 129-134; pp. 387-393, Introduction pp. 118-120, OB problem solving model, pp. 120-124, Human Behavior, pp. 124-126, Motivation, pp. 126-127, Performance Appraisals, p. 135, Miscellaneous short topics, pp. 134-139

VP MBA: Effective Leadership, pp 91- 92, Performance Evaluation, pp 86-88, Compensation, pp. 88-89, Motivation, pp 89-90, Group Decision Making pp 81-83

HBR Article: [What Great Managers Do](#), Marcus Buckingham (HBSP download)

HBR Article: [What Effective General Managers Really Do](#), John P. Kotter (HBSP download)

HBR Article: [Capitalizing on Capabilities](#), Dave Ulrich; Norm Smallwood (HBSP download)

Case: Claris Lifesciences Ltd, Rama Velamuri; Rosie Innes (HBSP download)

Case: The Breakfast of Champions: Can General Mills Make the Dough with Pillsbury? (A), Ryan W. Quinn; Gerry Yemen (HBSP download)

Organizing and Organizational Change

TDMBA: Organization Structure and Departmentation, pp. 139-150, Organization Change, pp. 153-157

VP MBA: Organization Structure and Departmentation, pp 83-86

HBS Press Chapter: [Organizing the Enterprise: Which Form Is Best for You?](#), HBS Press (HBSP download)

Case: Bausch & Lomb: Regional Organization, John A. Quelch; Nathalie Laidler (HBSP download)

Case: Management Levels at Staples (A): Company and Organization, David A. Garvin; Lynne C. Levesque (HBSP download)

Interviewing, Hiring, and Selecting; Giving and Receiving Feedback

TDMBA: Office Procedures, pp. 134-139.

VP MBA: Performance Evaluation, pp. 86-87.

“The Two Most Important Management Secrets: The Pygmalion and Galatea Effects,” [Susan M. Heathfield](http://humanresources.about.com/od/managementtips/a/mgmtsecret.htm), About.com, <http://humanresources.about.com/od/managementtips/a/mgmtsecret.htm>

Higgins, Monica. “A Note on Interviewing.” (HBSP download)

Roberts, Michael J. “Note on the Hiring and Selection Process.” (HBSP download)

James, Erika and James Clawson. “Giving and Receiving Feedback.” handout

Case: SG Cowen, New Recruits; Thomas DeLong and Vineeta Vijayraghavan (HBSP download)

Case: A Day in the Life of Alex Sander: Driving in the Fast Lane at Landon Care Products;

Larry Greiner (HBSP download)

Marketing Basics

TDMBA: Marketing, pp. 1-32

VP MBA: pp. 93-99

Levitt, Theodore, “Marketing Myopia.” (HBSP download)

Kumar, Sameer and Arya Kalla, “A Note on Sizing the Sales Force.” (handout)

Dolan, Robert J., “Note on Marketing Strategy.” (HBSP download)

Case: SAT & Co: Market Orientation (Ivey Publishing)

Marketing Research

TDMBA: Marketing, pp. 32-59

VP MBA: Marketing, pp. 99-128

Ninov, Nino, “Determining Market Size: Sources of Market Information on the Web.” (handout)

Parry, Mark E., “Measuring Consumer Price Sensitivity.” (handout)

Anderson, James C. and James A. Narus, “Business Marketing: Understand What Customers Value.” (HBSP download)

Stein, Ellen and Marco Iansiti, “Understanding User Needs.” (HBSP download)

Case: The Springfield Nor’easters: Maximizing Revenues in the Minor Leagues” (HBSP download)

Branding

Maruca, Regina Fazio, “How Do You Grow a Premium Brand?” (HBSP download)

Branding: Differentiation That Customers Value (HBSP download)

Vishwanath, Vijay and Jonathan Mark, “Your Brand’s Best Strategy” (HBSP download)

Ward, Scott, Larry Light, and Jonathan Goldstein, “What High-Tech Managers Need to Know About Brands.” (HBSP download)

Case: Mountain Man Brewing Company: Bringing the Brand to Light (HBSP download)

Globalization

Isenberg, Daniel J. “The Global Entrepreneur.” (HBSP download)

Case: Samsung Electronics Company: Global Marketing Operations (HBSP download)
Article: McDougall, P., B. Oviatt, and R. Shrader, "A Comparison of International and Domestic New Ventures." Journal of International Entrepreneurship, 1, 59-82, 2003.
<http://wf2dnvr13.webfeat.org/APC3N174/url=http://www.springerlink.com/content/r71676m6250841u7/fulltext.pdf>

Accounting & Finance

Guest Speaker

Tracy: pp. 3-49

TDMBA: pp. 71-104; 115-118

VP MBA: pp. 171-202

Materials Provided

Accounting & Finance: Cash Flow

Tracy: pp. 50-99

Berman, K., J. Knight, and J. Case. "The Magic of Managing the Balance Sheet" (HBSP download)

Lynch, L. and P. Simko, "The Conceptual Framework Underlying the Preparation of the Statement of Cash Flows" (handout)

Accounting & Finance: Financial Statement Analysis

Tracy: pp. 100-148

TDMBA: pp. 104-115

VP MBA: pp. 203-234

Schill, M. "The Thoughtful Forecaster" (handout)

Case: "Ceres Gardening Company: Funding Growth in Organic Products" (HBSP download)

Accounting & Finance: Valuation and Variance

Tracy: pp. 150-195

TDMBA: pp. 226-253

VP MBA: pp. 235-340

Chaplinsky, S. "Valuing the Early Stage Company" (handout)

Case: Valhalla Partners Due Diligence (HBSP Download)