AC 2009-1668: DEVELOPING AND ASSESSING A CASE STUDY FOR TEACHING ENGINEERING ENTREPRENEURSHIP AT SAN JOSE STATE UNIVERSITY

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Experience of Developing and Assessing a Case Study for Teaching Engineering Entrepreneurship at San Jose State University

Abstract

In this paper the authors share their experience of developing a case study for teaching engineering entrepreneurship and subsequently developing assessment and instructional material for the case. We also present the lessons learned from that experience.

The authors developed the case study in question on the basis of a survey of engineering students' perceptions of entrepreneurship[6]. Our survey showed that many students were interested in entrepreneurship, but were hesitant about starting their own business. We proposed two complementary approaches to learning, namely, case studies and active learning, to enhance the engineering students' understanding of the entrepreneurial process and dispel some of their commonly held fears and myths about entrepreneurship. The authors wanted to develop a case study on a local, Silicon Valley-based company so as to make it more relevant to the students. Since a large proportion of SJSU engineering students are foreign-born, we wanted the case to focus on an ethnic minority immigrant entrepreneur. We used a stage-wise process in developing a case study on the founding of Serus, a global provider of technology and managed services for companies with distributed or outsourced manufacturing operations, based in a Silicon Valley, California. The stage-wise process included the following steps:

1. Desk research on the case study company and the industry
2. Face-to-face interviews with the both founders
3. Transcription of interviews
4. Compared findings from interviews with the *a priori* learning objectives of the case
5. Prepared first draft of case study and instructor's notes, including a rubric to assess students' responses
6. Presented the case at the Embryo session of the NACRA Conference
7. Prepared a list of follow-up questions to elicit further details on key issues, based on feedback received at the conference presentation
8. Contacted the entrepreneurs for further information
9. Modified the case based on information obtained from the entrepreneurs and from secondary research
10. Tested the case study in class and administered a survey to receive students' feedback on the case
11. Further modified the case based on student feedback

The case study was included in the syllabus for the Introduction to Entrepreneurship course during Fall 2007 and 2008. Engineering students take this Entrepreneurship course to obtain a minor in business or as a technical elective course. The students in the class were asked to answer four essay questions based on the case. An analytic rubric was designed to assess the responses of each of the essay questions. Implementation of the rubric along with the students' feedback suggested the need for some changes in the case study as well as in the rubrics to better impart the learning points of the case study. This paper discusses how the case study and rubrics were modified to help us achieve the desired student learning objectives.

Introduction

Case studies, which usually describe real life situations, are a valuable teaching tool for building knowledge, illustrating theoretical concepts in practice, and developing analytical ability[1, 2]. Cases were first used as a pedagogical tool for studying managerial decision making at Harvard Business School in the early 1900s [2]. In contrast to lectures, which involve passive learning by students, case studies promote active learning where students evaluate a real life situation, identify the problem, and suggest possible solutions. In evaluating the solutions, students understand key theoretical concepts through self-discovery. Hence, case studies can be a much more interesting and memorable learning experience for students. In this paper, the authors share their experience of developing a case study for teaching engineering entrepreneurship and subsequently developing assessment and instructional material for the case. We also present the lessons learned from that experience.

Case Studies for Teaching Entrepreneurship

Several authors have written about what is involved in writing a good teaching case. For example, Farhoomand (2004) [3] states that a good case study must be linked to theoretical concepts that are learned through the case. The case should provide interesting insights into the context, the protagonists' characteristics, and the issues described. At the same time, it should be challenging for students and suggest alternative solutions to a problem, so that students are compelled to evaluate and decide between the alternatives. Cases that lend themselves to creative classroom dynamics, such as role playing, have added value. A good teaching case presents the managerial problem that needs resolution and action. It puts the students in the manager's shoes, which increases their involvement in the case[1].

It is common practice to understand the need of the customers before starting a project. The literature on writing a teaching case recommends thinking about or understanding the needs of the customer – the student – in terms of what theories will be conveyed or taught through the case, how it will fit into the course, and how the instructor will use it for teaching purposes. An extensive amount of effort is spent on identifying a case that will meet the requirements of the instructor. Once the case is identified, the instructor needs to see if the case is sufficiently interesting and rich in terms of the contextual setting, cultures, urgency of issues, and most of all have access to gather the necessary information for developing the case.

According to Farhoomand (2004) [3], a case typically has three main parts: an opening paragraph that provides an overview of the situation and highlights focus of the case. It does so by answering questions relating to: what, who, why, where, and when. The second part is the body of the case that tells the story by providing background information on the company and industry, and the issue facing the company. The third part is the conclusion, which summarizes the main issues and the dilemma that needs to be resolved.

Perhaps the most important aspect of the case study is the teaching note or instructor's manual. It is the case writer's contribution to education that other instructors can use.

The preceding arguments are equally relevant to developing and writing cases on entrepreneurship. In reality, as Carsrud (n.d.) [4] asserts, business problems are complex and confusing issues; entrepreneurial problems are even more "messy" just like entrepreneurs themselves at times. This makes the task of writing them up in a case, to present them in a simplified and straightforward fashion, a difficult and time-consuming task.

The authors experienced several challenges of writing an entrepreneurship case study while developing the Serus Case, as described subsequently in this paper. While all business or management cases require gathering background information about the industry, the market, competition, and the company, these are more difficult to gather in the case of new ventures. The newness of the start-up makes it impossible to gather historical data on the company. Since new ventures are privately owned and controlled by the founders, it is not possible to find any public information about the companies. The entrepreneurs and their investors are understandably reluctant to share information with "outsiders" in case it jeopardizes the competitive advantage that they are trying to secure. Access to gathering information from the main protagonists becomes all the more important in entrepreneurship cases. Moreover, technology entrepreneurs typically enter or even create new markets, which makes it hard to collect historical data on that market. Thus, most entrepreneurs operate and make decisions in a situation of incomplete information, ambiguity, and uncertainty. This business reality can be difficult to convey to students, especially, to engineering students, who are used to making rational decisions based on factual data.

When the authors started writing the Serus case, accessibility of information was not an issue since one of the authors knew a co-founder of the company. It turned out that as the case evolved after a few round of teaching and presentation at the North American Case Research Association (NACRA) conference in 2006 [5], we needed to include additional financial information about the company in order to help student evaluate the situation presented in the case and make meaningful recommendations. At that stage, the founders were reluctant to share their financial data with us.

Selecting a Case and Issues

In order to determine the exact focus of our case, we decided to start by undertaking a survey of engineering students at San Jose State University (SJSU) to gain an insight into their perceptions of entrepreneurship. Our survey revealed that SJSU's engineering students were interested in learning more about entrepreneurship [6]. However, they were hesitant to start their own businesses. Some of the common perceptions about entrepreneurship that the students expressed were: starting a business "needs lots of money" and involves taking risk "on your own." At the same time, "running a business can be easy".

As a result of the preliminary student survey, we developed a statement of purpose or a list of learning objectives that we ideally wanted a case study to address. Our aim was to dispel some of the commonly held myths voiced by the students, by providing the example of a successful new venture that had been started without a lot of money by a team of individuals, and that illustrated the complexities involved in starting and growing a new business. Our objective was therefore to prepare a case study about an entrepreneur who chose to bootstrap his or her new venture rather

than opting for venture capital finance and a technology entrepreneur who decided to team up with other co-founders rather than starting solo. In addition, we believed that a local high-tech start-up based in Silicon Valley would have greater relevance for the engineering students, as would a founder belonging to an ethnic minority group, since a majority of SJSU's students belong to minority communities. Furthermore, we hoped to be able to develop a case about an SJSU graduate, who could be a powerful role model for our students.

Based on our initial statement of purpose, we began by researching the 150 fastest growing companies in the San Jose area. We found that our first choice companies, which included well-known names like EBay, had already been studied extensively. Moreover, most of the companies were over five years old and too mature to be regarded as new ventures. In many cases, the companies were publicly owned and the original founders were no longer involved in running the company. As an entrepreneurship case study, it was imperative to select a company that continued to be managed by the founders. We also tried to identify companies in the list that were founded by SJSU alumni. These criteria considerably shortened the list of potential companies. After spending a few weeks doing desk research, we approached the CEOs of the two companies that we had identified based on our criteria. Neither company responded to our efforts to contact them. We soon learned that there was a key criterion we had overlooked, namely, the willingness of the company co-founders to participate in our research. At the same time, we realized that a fast growing start-up was more likely to be privately held, implying that company information could not be accessed without the consent and cooperation of the founders and managers.

We decided to select Serus Inc. as our case study, even though it was not in top 150 companies' list. Our decision was driven by a combination of several factors.

In 2005, Serus was identified as an 'emerging star' technology start-up by TiE, the world's largest non-profit network of entrepreneurs founded in Silicon Valley in 1992 (www.tie.org). At the time, Serus was a young company that had been founded less than 4 years previously. It was located in Mountain View, California, less than 15 miles from San Jose State University. The co-founders were two women, one of whom – Indu Navar – was of Indian origin and an engineering graduate of California State University (CSU). She could therefore be a role model for our students and someone that our students could identify with. Moreover, one of the authors of this paper became acquainted with Indu Navar, who agreed to share her start-up experience with us. A personal connection with one of the founding team members would surely facilitate relevant data and information gathering for developing the case study.

A brief narration of Serus' start-up experience by its co-founders at the annual TiE Conference in May 2005 suggested that the founding of Serus exemplified many of the learning objectives that we aimed to illustrate in our case study.

Developing the Serus Case study

Once we decided to focus on Serus for our entrepreneurial case study, we followed a stage-wise process in developing the teaching case study. This section describes the steps of the process and the rationale for adopting that approach.

Step 1. Desk research on the case study company and the industry
Factual details of the company, including its start-up history, product overview, founders, management team, investors, Board of Directors, location, and initial market conditions, including the competitive environment and industry conditions at the start, were gathered from the company's website and an extensive internet search. We wanted to gather as much knowledge as we could about the company as well as the industry it operated in, before conducting our primary research. After gathering secondary information from the internet, the next step was to have face-to-face interview with the co-founders of the company.

Step 2. Face-to-face interviews with co-founders
In the summer of 2005, one of the authors of this paper conducted face-to-face interviews with the two co-founders as well as a management team member. The interviews were based on a list of open-ended questions about the start-up of Serus. We asked the following questions:
- Why did the co-founders, Indu Navar and Barbara Hoefle, decide to become entrepreneurs?
- How did they meet and why did they decide to partner with each other?
- What was the genesis of their business idea and how did they come up with it?
- How did they discover a gap in the market and how did they validate their hunch?
- How did they propose to address that market need?
- Who were their initial competitors?
- How did they fund their new venture
- How did they win their first customer?
- What made them succeed as a start-up when all the other companies were failing during the dot-com crash?

Many of the questions led to follow-up questions during the interviews. For instance, when asked about their potential competitors, the co-founders listed several large companies. That led to a follow-up question about their views on the rewards and risks of venturing into a market that already had big vendors in it.

Step 3. Transcription of the interviews
All the interviews were videotaped and later transcribed. The interviews and their transcription formed the basis for the first draft of the case study.

Step 4. Comparison of findings from interviews with *a priori* learning objectives of the case, which were:
- Funding is not necessarily always the major constraint for a start-up
- A bright idea is not sufficient for starting a company
- Search for a gap in the industry ('must have' as opposed to 'nice to have')
- New start-ups don't necessarily have to stay away from a market that has big players
- Focus on meeting customers' needs
- Understand the customer's needs (use all communication channels one can access)
- Bring together skills, make a plan, and work out a plan
- Forming a founding team can necessitate being entrepreneurial

- Angel financing

A review of the interview findings revealed that all the *a priori* learning objectives were demonstrated in the case.

Step 5. Prepared first draft of case study and instructor's notes, including a rubric to assess students' responses
First draft of the Serus Case was prepared along with the instructor's notes. The instructor's notes highlighted the learning points of the case and provided answers to them. It suggested a list of discussion questions based on the case, namely:

- What was the motivation behind this idea?
- Why did the co-founders decide to collaborate? What lessons do they offer in choosing partners and team building?
- How did the entrepreneurs come up with their business idea?
- How did they discover an unmet customer need in the market?
- How did the founders finance their new business?
- How did Serus address the market need they identified?
- What risks did they take? How did they minimize the risks?
- What are the main learning points for aspiring entrepreneurs offered by the case?

This case study was used in a mid-term exam for the Introduction to Entrepreneurship course taught by one of the authors in Fall 2006. The course is a core course for engineering students taking a Business Minor. The students were asked to answer the following four short answer questions:
- How did the founders come up with their business idea?
- What lessons do they offer in team building?
- What risks did they take? How did they minimize risks?
- What are the main learning points for aspiring entrepreneurs offered by the case?

For each question, we prepared a comprehensive and, in our view, a perfect answer. The latter included a list of bullet point responses with details for each. Next, we constructed a grading rubric of 1 to 5, according to which:
A score of '1' implied a very inadequate or poor answer to the question
A score of '2' implied about half the bullets we had identified were listed, but the answer lacked detail
A score of '3' implied about half the bullet points were listed in detail
A score of '4' implied that more than half the bullet points were listed but some lacked detail
A score of '5' implied that most of the bullet points were listed along with details of why they were important

The above rubric focuses on the content of the answer, which may be regarded as a limitation. This aspect is discussed subsequently in the section on assessment of the case study.

Step 6. Presentation of the case at the embryo session of the North American Case Research Association (NACRA) conference [5]

In October 2006, we presented the first draft of the case along with the teaching note at the embryo session of the NACRA conference. Around a dozen academics, including a couple of experienced case writers, gave us informal, oral feedback on our case. Their main criticism was that the case lacked a central critical incident or key decision point. They suggested that in order to publish the case and make it valuable for teaching purposes, it needed to focus on a key entrepreneurial decision, which involved potentially competing solutions. Students would then be asked to read the case, evaluate the alternatives, and decide what action to take.

Step 7. Preparation of a list of follow-up questions to identify key entrepreneurial decisions, elicit further details on key issues, and clarify factual details, based on feedback received at the conference presentation.
To elicit further details that could not be obtained from the transcription and face-to-face interviews, we prepared a list of follow-up questions. It included questions such as: What was the most difficult decision point for you (at the start and in growing the business)? Why was it difficult to make? What were the main considerations? How and why did you arrive at the final decision? In addition, we asked several questions of clarification. These included: When exactly did you meet your co-founder (mm/dd/yy)? When exactly did you start speaking with friends and acquaintances in the field of supply chain management? What were your competitors doing in the dot.com era? When did you meet Dr. Nag (your first angel investor)? When did you meet Leila (the contact that led to the first customer)? When did you figure out that though your friends were running successful e-commerce businesses, the shipping was not so efficient? When did you decide to come up with global web-based real-time software that could be reused? When did you begin to find customers and investors for your product? When did you meet one of the Directors of Quantum Corporation (first customer)? When did you come up with a solution for Quantum? What was the purpose of the software that you had written before you met one of the directors at Quantum Corporation? Between January 2001 and June 2006, what major contracts did you obtain and from which companies? When did you obtain each of these contracts? Can you give us details on the financial status and size of Serus from 2001 to 2006? What were the landmarks from start-up to a company that is growing fast?

Step 8. Contacted entrepreneurs for further information
We sent our list of questions to the co-founder and Chief Executive of the company. She promised to respond "soon" but there was no response for several weeks. Finally, the authors arranged to meet with her face-to-face, to elicit a response. At the meeting, the entrepreneur described the two most difficult decisions she had faced: first, whether to go for venture capital funding and second, what customer market segments to focus on as the company began to grow. She gave us some basic details about customer and employee numbers, but was unwilling to provide detailed financial statements.

Step 9. Modification of the case based on information obtained from the entrepreneurs and from secondary research.
Based on the information obtained, we modified the case by including information about the potential market segments that Serus considered entering at the time that it started to grow (around 2003, a couple of years after start-up). Indu Navar had mentioned that they had debated between entering the high tech, semi conductor, medical devices, and consumer products markets. We therefore tried to research these markets and included data on the market size and

growth rates of the semi-conductor market and the medical devices market. Information on the other two segments proved difficult to find. We also included some information on the growth trajectory followed by the company, in terms of increase in the number of customers and employees per year. The purpose was to highlight the fast pace of growth, raise questions about how to finance that growth, and discuss whether or not the entrepreneurs needed a large injection of funds by way of venture capital funding. The teaching note for the case was accordingly amended and the following questions added:

- What market segments should Serus focus on as it grows? Why?
- Could venture capital funding be considered a good option in this case? Why or why not?

Step 10. Tested the case study in the class and administered a survey to receive students' feedback on the case.
In Spring 2007, the students on the Entrepreneurship course were given a modified Serus case, which was discussed in class. Later, the students were asked to give feedback on the case study using the following questions:
What lessons did you learn from the Serus case study?
What would you regard as the main strength of the case?
What would you regard as the main weakness of the case?
Would you recommend that we include this case in future courses?

Their responses suggested that most students believed that the case emphasized our original learning points, namely:
- Funding is not necessarily the major constraint for a start-up
- Entrepreneurs have to search for gaps in the market, understand, and meet, customer needs
- Start-ups don't necessarily have to stay away from a market that has big players
- Most students said that the case helped them to understand the value of bringing together complementary skills, making a plan, and working out a plan. Lessons about building teams seemed to be the most powerful learning from the case.
The main strength of the case was that it was interesting and easy to read.
The main weakness was that it did not provide enough information to make a decision regarding what market segment to enter and whether or not to seek venture capital funding.
Almost all students believed that the case should be included in future courses.

Step 11. Further modified the case based on the student feedback
The case was modified to include more information about the market and about competitors in the industry.

Assessing the Case Study

Drawing on Bloom's taxonomy, case studies can serve several educational purposes, as discussed by Naumes and Naumes (1999: 27) [2]. These include:
- knowledge acquisition and developing concepts
- comprehension or understanding techniques and applying concepts
- acquire skills in use of techniques
- acquire skills in analysis of business problems
- acquire skills in synthesis of action plans

- develop useful attitudes and an internal value system
- develop mature judgment

The Serus case serves all these purposes to some extent. It enables students to learn about how entrepreneurs make decisions under conditions of incomplete information and uncertainty. It emphasizes the benefits of multi-disciplinary founding teams so that founders can add value to each other by possessing complementary skills. It applies concepts learned in class about team building, identifying target markets, and determining sources of finance at start-up. It tries to apply theoretical concepts that relate decision making to the stage of growth of a new venture. Using the five stages of small business growth identified by Churchill and Lewis (1983) [7], it is possible to evaluate how decisions can evolve depending on whether the company is at existence, survival, success, take-off, or resource maturity stage. Since the case is not about ethics, it does not aim to develop useful attitudes except to encourage open-mindedness among entrepreneurs to network with and learn from those around them. In the end, it tries to enhance students' decision making skills under conditions of ambiguity.

Based on our experience of using the case in the classroom, we have modified it further to emphasize this last 'fact' to the students, namely, that entrepreneurs typically have to make quick decisions based on limited information.

As regards designing a scoring rubric, we realized that our original rubric focused on the content of the answers. We have tried to revise the rubric to make it broader and applicable to every question, based on Bloom's taxonomy [8]. We therefore review three aspects:

1. Knowledge/comprehension: to describe key elements of the case, the characteristics of the co-founders), and the methods they used to identify their business idea, to find their first customer, and fund their new venture.
2. Application/analysis: to understand the merits of the co-founding team, their method of identifying a market opportunity, the decisions they made regarding start-up finance.
3. Synthesis/Evaluation: to assess the risks of the decisions they made, to evaluate the decisions they ought to make regarding finance for expansion and markets for future growth.

We then evaluate the answer to determine the extent to which it satisfies all three of the above criteria as well as communication skills. Thus,
1 = demonstrates little or no knowledge of the facts; makes little or no connection between issue/problem and theory; integrates few or no concepts from the class text; makes limited recommendations; spelling errors are frequent; hard to follow ideas
to
5 = demonstrates a clear understanding of the facts, a deep understanding of the issue/problem in the case and the theory; makes insightful connections between the problem and theory; accurately integrates conceptual material from the class text'; makes realistic, appropriate, insightful, recommendations clearly supported by the information presented, theory, and logical reasoning; writing is free of grammar and spelling errors.

In Fall 2007 and Fall 2008, we used our modified rubric to assess students' answers to the four case study questions listed previously. An evaluation of the questions suggested that the first

question: 'How did the founders come up with their business idea?' aimed to evaluate students' knowledge and comprehension of the case study. Question two: 'What lessons do they offer in team building?' required students to apply theories relating to teams learned in class to the case study. The third question: 'What risks did they take? How did they minimize risks?', required students to demonstrate synthesis and evaluation of the case. The fourth question: 'What are the main learning points for aspiring entrepreneurs offered by the case?' aimed to test all three of the learning objectives, namely, comprehension, application and analysis, as well as synthesis and evaluation.

In Table 1, we summarize the average scores of the students on the Introduction to Entrepreneurship class, who answered the questions as part of their midterm test.

Table 1: Summary of Students' Responses to the Case Study Questions

Semester	Number of Students	Average Scores			
		Q1	Q2	Q3	Q4
Fall 2007	39	3.55	3.53	3.79	3.81
Fall 2008	45	4.2	3.89	3.88	4.3

A comparison of Fall 2007 and Fall 2008 average scores shows that the students scored marginally better in 2008 than in 2007. There can be several explanations for an improvement in the students' performance. Firstly, the instructor (one of the authors of this paper) ensured that the theories relating to team building and risk taking were discussed in class prior to the midterm test in Fall 2008. As a result, the students were able to draw on the theories learned in class and apply those to the case study, instead of trying to inductively learn the theory from the case. In both semesters, the case questions were set as open book exams, implying that students could consult the text to answer the questions. However, the instructor's experience suggested that students were more likely to connect theory with practice, if the theory had been explicitly discussed in class. Secondly, in the instructor's opinion, the 2008 student cohort seemed, on average, to possess superior reasoning and analytical skills than the 2007 cohort. The comparatively higher score on the fourth question was unexpected since the question required analytical skills rather than comprehension. In part, it reflects the open-ended nature of the question because of which the answers were quite diverse and therefore more difficult to compare or evaluate using a rubric. While a few students suggested a large number of learning points, others went into details of a few, key, learning points We propose to modify Q4 and accordingly modify the rubric to remove the diversity in responding to the question.

In future, we plan to provide students with this rubric in advance, before they tackle the case study. This would clarify expectations and make the grading more transparent. For the fourth question, we propose to specify that students must list three central learning points and substantiate their choice, which would be reflected in the rubric provided to them. We believe that these changes will streamline the grading and make it more objective.

Conclusions

This paper has attempted to shed light on the process of writing an entrepreneurship case study for teaching purposes. It has described the steps taken by the authors to write the case study, the iterations that has involved, in terms of seeking feedback from fellow academic case writers as well as students, and seeking further information from the entrepreneurs described in the case. Developing the Serus case study has been an enormous learning experience for the authors. In writing this case study, both authors ventured into a new method of doing and publishing research. It proved to be a valuable, but also challenging, experience for us. Prior to writing the case study, we were unaware that a teaching case must focus solely on presenting the facts; it should not include the authors' value judgments about the personality of the protagonists, their strategies, or the company's performance. This is to enable the students to understand and evaluate the facts for themselves and draw their own conclusions. In that sense, a case study is quite different from a research article where the researcher provides the facts, analyzes those facts, and draws conclusions and implications. It is for this reason that the instructor's manual or teaching note assumes significance, since it is in the instructor's manual that the case writer relates the case to theoretical concepts, explains how the case illustrates and draws upon those concepts, and suggests the reasoning that readers of the case (the students) could use to evaluate alternatives and select the most appropriate course of action.

While many case studies are written each year, the process of writing a case study is not widely understood. We do not claim to draw generalizations from our limited experience. However, our experience points to some lessons that may be useful to future case writers who are new to the field. In particular, we would recommend that case writers arrive at a clear understanding with the entrepreneur about time commitments involved in discussing issues and eliciting information, as well as the need to share sensitive financial information with them. The latter requires a high level of trust between the entrepreneur and the case writer. In exchange for the information, the case writer could offer "free advice" for the entrepreneur, based on the case writer's knowledge of theory and other cases. The case writer also has to emphasize the fact that the case is purely for teaching purposes and will create wide awareness of the company among students, who form part of the pool of future employees for the company. Finally, case writers have to be patient and willing to understand the competing demands on entrepreneurs who are growing and managing their own company.

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