

**2006-225: TECHNOLOGY, CULTURE AND THE MANUFACTURING ENGINEER:
HOW STUDYING SME'S IN CAMBODIA CAN TEACH MANUFACTURING
STUDENTS ABOUT GLOBAL ENTERPRISE**

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Technology, Culture and the Manufacturing Engineer: How studying SME's in Cambodia can help teach manufacturing students about global enterprise

Introduction

In his book “The World is Flat”, Thomas Friedman describes what he calls “the quiet crisis” as the “erosion of America’s science and engineering base, which has always been the source of America’s innovation and our standard of living.” [1] The crisis is the increasing penetration of global competition on the economic output of the United States, now an issue to which engineering education is paying serious attention. However, it is not a crisis of just technical issues. What is needed with respect to global learning and experience is more than just technical competence and expertise. Bill Wulf said “...engineering is now practiced in a global, holistic business context, and engineers must design under constraints that reflect that context. In the future, understanding other cultures, speaking other languages, and communicating with people from marketing and finance will be just as fundamental to the practice of engineering as physics and calculus.” [2] For faculty and students and BYU, a recent project of studying manufacturing in Cambodia also became a study of Cambodian history, government, and culture. As a result it became, for both students and faculty, a learning experience in the broader, more holistic context of manufacturing, engineering, technology, and global issues.

Rationale and Organization of the Learning Experience

The Manufacturing Engineering Technology program at BYU has been increasing its focus on global aspects of engineering and technology for several years. Our goal is to provide more effective opportunities for faculty and students to gain an awareness of, knowledge about, and experience in issues and opportunities of international business and global manufacturing. One of the primary areas of focus is locating and organizing international internships for undergraduate and graduate students, while at the same time working to provide opportunities for faculty to stay abreast of the global issues. Our internship effort has taken two approaches: one focuses on arranging 4-6 month paid internships with companies located in various countries, primarily in Asia. The other approach, and the one used for the work described in this paper, focuses on collaborative learning for faculty and students and takes a broader view of the overall environment for manufacturing-type companies, primarily in developing countries.

A summary of the two approaches, in terms of requirements and characteristics, is given below:

- Company Focused
 - In-depth experience in company processes, operation.
 - Management and faculty time requirement minimal.
 - Insight is gained into company issues in globalization such as material acquisition, capacity planning, supply chain, quality, educational challenges, etc.
 - Company pays expenses of students and provides modest salary.

- Country Focused
 - Broader experience in sector/country issues, problems and opportunities.
 - Contribution to sector/country.

- Research opportunities for graduate students/faculty.
- Broader perspective of importance and role of industrial sector in development.
- Financing must be obtained to carry out this effort.

Case Study: Learning About SME's in Cambodia

Our study of SME's in Cambodia illustrated to us the importance of these small manufacturing companies in the economic development of this emerging economy. We found a surprising number of highly-motivated and successful entrepreneurs and small business owners who were fighting an uphill battle against corrupt government practices, a lack of capital, and a lack of workers with appropriate education and training. Based on interviews with business owners, government officials, and consultants some of the roadblocks to economic development are related to the history and culture of Cambodia and the Khmer people.

Thirty seven companies surveyed as part of this study provided two important things: first an overall perspective of the conditions and challenges faced by SME's in Cambodia, and second, a way to locate SME owners that fit the criteria we required for the in-depth interviews. The interviews with companies normally took 2 to 3 hours. After asking the survey questions and discussing the business environment, most companies were happy to provide a tour of their facility, which allowed us to become more familiar with their manufacturing operations and with the company owner.

The companies surveyed all produced actual physical products as their primary business. These included various plastic, metal, glass, rubber, wood, food and clothing products. All were located in or near the city of Phnom Penh, the farthest away being approximately 50 km from the city. Before traveling to Cambodia numerous contacts with government and NGO operations were made to set up visits before arriving in country. However, these contacts, in the end were not utilized, as these organizations seemed more interested in directing our work beyond the scope of our original plans and in limiting our visits to their own contacts. Therefore, we decided to wait until we arrived in-country to make our own contacts and found great success in finding a variety of companies that were happy to speak with us. Within one week of arriving, more contacts and referrals were available than we had time to visit, representing a wide variety of industries and company sizes.

Based on survey results, we found that the environment and situation in the SME industrial sector in Cambodia is a mixed bag. Some very positive things are happening, but basic needs to support industry such as infrastructure and education are still lacking. As an example, one source claims that Phnom Penh has more than 20,000 private generators in the city [3]. Other infrastructure issues were raised, including the transportation system, for example, which is improving but still lacks good coverage, especially during the wet season when some roads may be under water and impassable for weeks at a time. This can be a real challenge for an operation that needs raw material and supplies for production, while at the same time needing to transport finished goods to market.

In terms of equipment and technology, most owners were aware of better equipment which they felt would improve their manufacturing operations; however, the cost of most of the equipment

and/or the cost of electricity to run them is prohibitive to the point that most use older technology or manual labor. Of the 32 smaller firms surveyed, only seven had computers and none used computer technology for anything other than internet access and some basic word processing though most were also aware that other capabilities existed. Cell phones were used by every operation and for most that was the only phone system available. Most incoming material and outgoing product transportation was accomplished by motorcycle or small truck.

One of the greatest challenges expressed by every company was corruption, which was also equated with instability in the government. Most people are optimistic about the future to a degree; however, this optimism was qualified with an “if”, when speaking of their hope that the government get their act together. This “if” colored the companies perspectives of the future and created caution regarding investment in growing their businesses.

Manufacturing and Development – Observations from the students

Companies in less developed countries face greater institutional obstacles than do firms in developed countries. For example, in developed countries, better banking and more access to financial opportunities provide greater growth opportunities [4]. For example, the number of these firms who still used a “cash box” rather than a bank was a surprise to us at first. Many of the SME owners told of friends who had used banks, but ended up losing all their money when a change in government or leader meant all funds were “confiscated.” Most who did use banks preferred banks in the United States, Australia or other developed countries and usually for the purpose of “retirement” savings. In addition, companies in developed countries have more access to better management and infrastructure, which tends to provide more opportunity to produce higher quality products and more dependable ways to get them to the customer [5].

Another challenge in Cambodia is the inability, and for the most part disinterest, of carrying out in-plant experimentation and process improvements, which may be attributed to inadequate education and lack of experience. This is true in most developing countries [6]. Improvement and experimentation are critical to being competitive in the international market. Related to technical ignorance the failure to realize that major benefits can be derived by improving the internal production processes and systems [7]. This weakness, which is not unique to companies in poor countries, has a major impact on companies from developing countries attempting to break into international markets, because poor quality, high relative cost of production, and poor inventory management are significant barriers to becoming competitive. Though we found a strong desire among most SME’s to improve their operations, few of them were actually doing much and they seemed to lack both the confidence and knowledge to proceed.

The small firms we interviewed tended not to keep documentation on technical advancements, problems, and solutions, and when it did exist the quality was very poor. Other than a box with customer orders, we found very little documentation of any sort. This means progress is slower and the chance of repeating errors, or of having to reinvent solutions, is higher [8]. Finally, lack of education is a serious problem [9]. Poor or inadequate education complicates resolving many of the previously mentioned challenges and unfortunately, inadequate education is not solved easily or quickly. With respect to technology, we discovered that it is less important than we thought it would be, but on the other hand the need for operational improvement is more critical

than we had anticipated. Originally we thought that these two things, technology and improvement, were dependently linked, but based on the data we collected it is our opinion that this is not the case. Both are important, but if the influx of technology lags it will not have as serious a consequence as a lack of initiative in pursuing manufacturing process and system improvements.

With respect to their position globally, even some Cambodians refer to themselves as “frogs in a well.” NGO and government officials claim that SME owners are not aware of, nor do they seek for, global opportunities; thus, part of the reason for the “frogs in a well” description. They also claim that there is a serious mismatch in what knowledge the country needs and what it given in education and printed material. [10]. For example, marketing textbooks used in a local Phnom Penh universities are from the United States, whose markets and market needs are entirely different from those in Cambodia [10]. Even though, in some respects, there is reason to question the perceived view of government officials regarding global opportunities (some high level government officials wanted to focus on producing music videos, for example), the concern about obtaining information and, knowledge for appropriate for the country’s needs is valid.

Currently, government policies and practices tend to limit Cambodia’s potential to exploit its own potential and to interact with other countries economically. One of the problems is clearly infrastructure, including lack of adequate roads, as discussed earlier. Another example is Cambodia’s ability to produce rubber, cotton, granite, and other raw materials. This should be a positive in the country’s economy, but the corrupt business and government environments result in higher quality materials leaving the country by smuggling. Meanwhile materials available in country are typically of poorer quality and higher cost [10, 11].

Another side of the issue deals with laws and agreements from developed countries such as the United States that hurt the Cambodian economy and social system. For example, quotas imposed by the United States cost thousands of jobs in the garment industry and millions in wages [11]. Other well-meaning, but sometimes misguided initiatives such as prohibitions on child labor also cause serious social problems. One of the companies we visited, but only because we had an internal contact, was extremely hesitant to allow visitors because the BBC had done a TV program on child labor and focused on this garment manufacturer [12]. What is not seen are the thousands of youth sold as sex slaves or pushed into prostitution, because their families feel they have no other option from lack of educational opportunities and from a need of money. Many are hesitant to talk of these issues, even so a quarter of those interviewed mentioned it, with most of them relating the experience of a personal relative or friend who had been affected by this problem. These are problems that are not easily solved, but which result from a lack of economic opportunity which must be addressed by improved government policies [13]. As students became aware of the multi-dimensional nature of challenges that they before might have thought were clear cut, they gained a deeper understanding of the importance of a broader perspective when trying to solve problems of a system, particularly international issues.

Impact on Students and Faculty

During the course of the Cambodia experience every participating student recognized the need to continue to learn about business, globalization and increased technical expertise. All have given serious consideration to graduate school, two have already started graduate work, another will

begin graduate school next year, and the last two plan on graduate work after spending some time in industry. The fact that these students want to attend graduate school, however, is not the main point. Rather it is that each of them realized more acutely than before the need to continue to learn about people, countries, cultures, and the global condition.

Although some of our observations are as much anecdotal, at this point, as empirical, we think that this country-focused internship has provided our students with exposure to a broader base of experiences and diverse learning opportunities than that available in a standard internship carried out in the U.S. We don't pretend that we can provide every student in our program with this type of international learning opportunity. However, the experience does impact other students through the discussions in class between faculty and students and changes in assignments by faculty to include elements of globalization.

The faculty of the Manufacturing Engineering Technology program at BYU have implemented changes and improvements in course and curriculum to further address the issues of globalization and leadership. It is clear that in order to help students make sense of the challenges and opportunities of engineering and technology careers in a global marketplace, the faculty must have a grasp of these issues. Nearly every course now has some level of discussion and some assignments which require students to consider international impact in the context of their class subject. These can include assignments which require students to investigate, specify, and cost products and processes which are sourced from companies in foreign countries. Another example is an engineering ethics class assignment where students learn how to do business ethically in countries with different sets of laws and customs. Finally, we hope to provide some regular opportunities for significant international experiences like the internships described in this paper. These initial efforts have been modest, but we plan to continue to enrich our curriculum with material on global manufacturing, in order to keep our program relevant to the dynamic manufacturing environment which our graduates face today. Most of the faculty in our program have been to China at least once to learn first-hand about the manufacturing capabilities, strengths, and weaknesses that exist in that country. First-hand experience is critical to understanding why American firms are outsourcing production to companies in Asia, to understanding when this type of outsourcing is the best option, and to determining when outsourcing may be the wrong choice.

In order to better understand how perceptions of students in the program a survey was recently administered asking student view regarding the impact of globalization in production and manufacturing, its impact on manufacturing engineers, the advantage of knowledge about globalization in their future work, and the importance of the MET program and faculty having knowledge about globalization. The same survey was given to 10 students who have all recently completed international internships, five of whom were involved in the Cambodia project. Students were asked to gauge their perspective of the listed topics before they entered the MET program and now after being in the MET program (all had taken at least the Introduction to Manufacturing Systems class). The scale ranged from 1 meaning strongly disagree to 5 meaning strongly agree. Two questions from this survey, listed in table 1 along with the responses, illustrate that even though all MET students appreciate the importance of understanding international issues, those who had completed international internships were totally and unwaveringly committed to its importance in their work and in the program. In fact, much of the

increase of appreciation among both faculty and students, for the need to understand international issues rests with the international projects such as the Cambodia project.

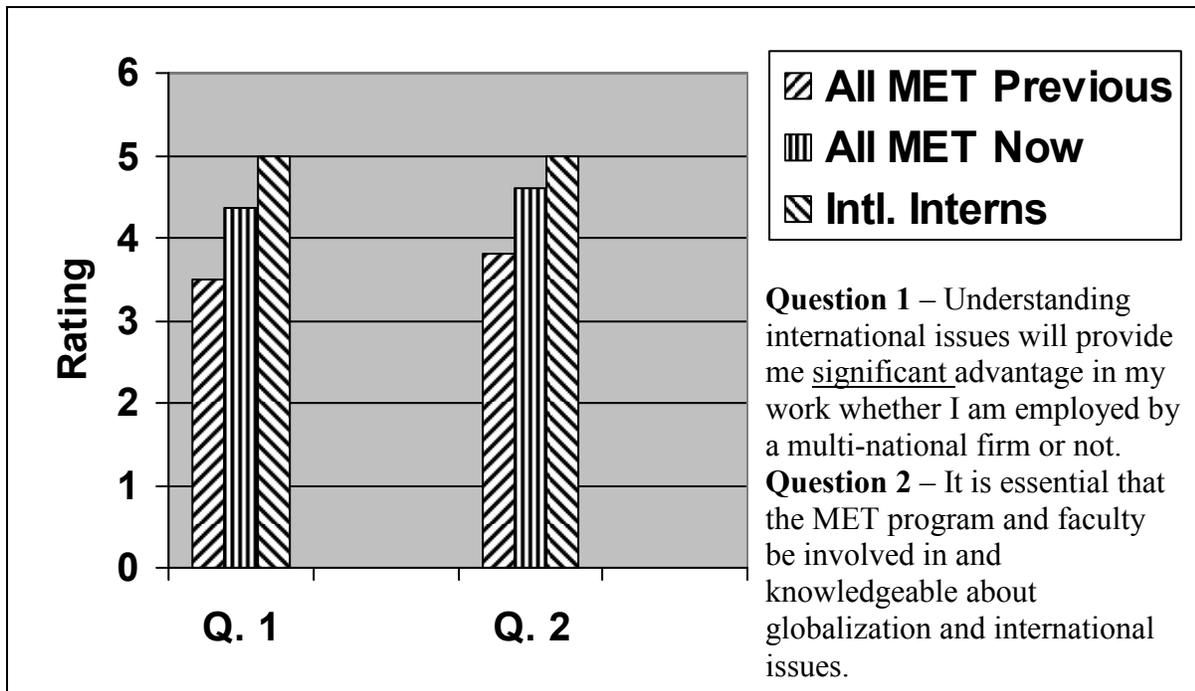


Figure 1.

The manufacturing engineering technology program is not the only group at BYU which is beginning to focus on the effects of globalization on their discipline. The college of Engineering and Technology has also recently begun a effort to focus on of globalization, multi-cultural needs, ethics, innovation and leadership through a multi-year strategic plan. This plan includes concrete actions like providing research funding, professorships, and travel and research funds to faculty interested in exploring the global aspects of their field. An internal faculty committee has also been established and charged with the task of improving the college capability in globalization, multi-cultural awareness, and leadership. Finally, an external committee composed of industry leaders has been engaged to help evaluate and guide these efforts.

Summary

The best summary of our experience in Cambodia may come from the students who participated. A post-internship survey provided a collection of comments which reflect the things they learned during a short five weeks and validates the claim that we must address more than technical issues in the educational experience. One student commented “what impressed me the most was that we experienced [the] real version of what we were studying in concepts on value chain management, manufacturing process improvement and nurturing growth in the developing world. It was more than simply academic. It was like having a large exclamation mark on everything I learned and had studied in Manufacturing Engineering Technology.”

Recognizing the link between good government policy and the health of the industrial sector another student said “Cambodians hold little trust in the government, which makes it difficult for companies to [improve]. The problem with companies being stifled by the government is the government [should] help these companies to make the economy, and nation, grow.” Yet another student expressed his admiration of the Cambodian people, stating “during our limited time there I was excited to observe the seeds of innovation and industry everywhere I looked. The people have enormous potential.”

Based on this pilot project in Cambodia, we believe that a country-focused internship model provides rich learning experiences for students and faculty, combining technical, historical, and cultural aspects of manufacturing and business. Our recent international experiences have motivated us to update our curriculum and to pursue the development of a sustainable, international internship program. We believe these efforts are necessary in order to better prepare our students to contribute to the dynamic, global manufacturing profession.

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