
AC 2011-2584: LEARNING IMPROVEMENT IN LEADERSHIP, TEAM-WORK, AND CONTEMPORARY ISSUES THROUGH A GLOBAL SUPPLY CHAIN PROJECT

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Learning Improvement in Leadership, Teamwork, and Contemporary Issues through a Global Supply Chain Project

Abstract

In this paper, we describe a learning improvement initiative centered on a production systems course project. This initiative addresses strategic production planning of a hypothetical global supply chain with contemporary environmental and energy consequences. The quantitative problems of this project are to be formulated and solved by student teams where each team member assumes a unique position of responsibility. They are: domestic and off-shore plant managers, a logistic manager, and an environment and energy manager. Given specific responsibilities for each managerial position, in solving a series of quantitative problems where the leadership of each project team rotates among teammates, students are not only able to produce multi-disciplinary solutions to this global supply chain company, but also able to demonstrate their leadership and teamwork skills. This initiative is motivated by a multiple number of ABET outcome items. The outcome assessment of this project consists of pre- and post-projects of the students as well as the rubrics for each outcome item to be utilized by the instructors. The progress made thus far in terms of input, process, and output including team organization and management will be presented. Also, challenges in this project will be identified, and future direction will be discussed.

Keywords: Global Supply Chain, Leadership, Multi-Disciplinary Team, Contemporary Issue Outcome Assessment

Introduction

In the era of business globalization and public debates on environmental and energy issues, numerous companies currently work on projects with team members from different disciplines and with different responsibilities. Hence, it is highly desirable for Industrial Engineering (IE) majors to learn and improve various skills and capabilities that advance the performance of the team such as leadership and team management as well as the knowledge of relevant contemporary issues. Characteristics of leadership and teamwork abilities have been widely presented in the previous literature [1, 2, 3, 4] while [5] introduced the key features of contemporary societal issues.

At the same time, the outcome items required by Criterion 3 of ABET for IE majors regarding team effectiveness and contemporary issues [6] are:

- (d) an ability to function on a multi-disciplinary team.
- (j) a knowledge of contemporary issues

Additionally, the Department of Industrial and Manufacturing Systems Engineering (IMSE) at Iowa State University (ISU) has one outcome item [7] on team leadership as follows:

- (m) an ability to provide leadership in multi-functional team

Under these circumstances, in this paper, we describe a junior level course project of a global supply chain for teams of mostly IE majors. This project is motivated by the current business practices in global supply chains, and it also aims to demonstrate and improve the aforementioned outcome items of (d), (j), and (m). In this project, students are expected to solve hypothetical global business problems considering logistics (transportation), accounting (tariff and exchange rate), and human resources (employment and salary) issues in totality. Our description is based on the student team project conducted in 2010 Fall Semester in a course titled Production Systems (IE 341) at ISU.

The rest of the paper is organized as follows. In Section 2, we will first outline the technical contents of the project from an IE perspective. In Section 3, we will illustrate the roles of each team member and how the outcome items (d), (j), and (m) are associated with the whole project. Subsequently, a description of the project implementation and management is presented in Section 4. This is followed by the assessment of the project in Section 5. Finally, we will provide the concluding remarks and comment on future works in Section 6.

Technical Contents of the Project

In this project, we consider a hypothetical agricultural product company based in Iowa, Blizzard Agricultural Products Ltd (or Blizzard). Blizzard produces her core product, the cattle feed, from distillers grains in two domestic plants, Decorah and Sheldon, IA (see Figure 1), and sells the product in the Chicago market. At the same time, Blizzard is expanding her production with a plant in Shanghai, China (see Figure 2), thereby forming a global supply chain with all kinds of logistical consequences such as a long distance supply line.

Roles of Team Members and Outcome Items

To demonstrate and increase the student capabilities with respect to the outcome items (d), (j), and (m), we instructed the students to think of themselves as managers to the hypothetical company, and solve the problems from economic, environmental, and human resources perspectives. Specifically, we let students form teams of 4 members each, and each student in each team selected a unique manager position with corresponding responsibilities throughout the project. The manager positions designed for this project were: domestic and off-shore plant managers, a logistics manager, and an environment and energy manager. The specific responsibilities are given in Table 1. Since this project is designed for IE major, we assume that all the students have basic technical skills that are attained in an optimization course, which is a prerequisite of this course.

Table 1. Responsibilities of Managers

Position	Responsibilities
Domestic Plant Manager	Try to maintain or increase the production quantity which is directly related to the maintaining of domestic employees
Off-Shore Plant Manager	Try to maintain or increase the production quantity which is directly related to the maintaining of off-shore employees
Logistics Manager	Try to increase the profit considering elements from different locations (e.g., Transportation, Tariff and Exchange rate)
Environment and Energy Manager	Try to maintain or decrease the carbon footprint measured in pounds generated during transportation

We note that these responsibilities of the individual managers are designed in such a way that induce competition and conflicts even in the best of business circumstances. Hence, through the challenging technical questions, we aim to encourage a resolution toward a common goal. Specifically, during the decision making process, students were asked to advocate his/her individual managerial responsibility within the team, and yet to communicate effectively to demonstrate their commitment to the team effort. In this way, the project provides students with an opportunity to learn how to collaborate with teammates to achieve a common goal via communication and compromise even when the questions at hand may be controversial. Furthermore, this project was intentionally designed for students to pay extra attention to some of the timely issues relevant to IE majors. For example, exchange rate

fluctuation is one of the most controversial challenges between U.S. and China, which is a key economic component to the survival of thousands of companies in U.S. and/or China.

As for the outcome item (m), the leadership of the company rotates among teammates phase by phase as the business decisions are made at a board of manager meeting and each manager serves as the leader of the board for his/her phase (see [8, 9] for similar project management strategies). A critical responsibility of the project leader is to lead the discussion among competing managers and coordinate the divergent suggestions for the purpose of achieving a common goal. Furthermore, a leader should also understand relationships and constraints involving the human, technical, as well as business aspects. We note that such details of expectations for the company leader and the followers were given in one of the project documents – Guidelines for Project Leader and Follower. In what follows, we will present the details of project management.

Finally, we note that, for each phase, the leader of the board of the manager is assigned to be the leader of the project itself. The project leader is expected to provide leadership in calling, conducting, and recording the meeting. In this way, each student is strongly encouraged to fully participate in the project.

Project Implementation and Management

The project was launched in the semester of Fall 2010 in the form of a project package. The whole project package includes: (1) Project Contents, (2) Guidelines for the Project Leader and Follower, (3) Responsibilities of Managers, (4) Guidelines for Board of Managers, (5) Project Report, and (6) Outcomes Rubrics. All the documents were made available in the course's website within the e-Library of ISU. This indirect and Internet-based approach of providing information to the students created a situation where students were encouraged to work together to interpret the various memos, and sort and differentiate the necessary information from other irrelevant and something less than clear information. In addition to the project package, an optimization (LINGO) tutorial session as well as two Q&A sessions were provided to help students comprehend and conduct their project better.

We note that LINGO is mathematical programming software used to solve the project problem [10]. Specifically, students formulated and solved a nonlinear problem with a

number of equality and inequality constraints. The mathematical programming formula was put in the LINGO input file, and the solution was generated in the LINGO output file. The students analyzed the LINGO output to obtain the solution for the project for discussion and recommendation. The LINGO tutorial was provided to the students two weeks prior to the launch of the project.

Two Q&A sessions were held for students during the implementation of the project. The objective of these sessions was to clarify the project contents as needed. For instance, the most frequently raised question during the Q&A sessions was how to utilize the results from LINGO to answer the questions which required both quantitative analysis (e.g., from an economic perspective) and qualitative analysis (e.g., from environmental and human – resources perspectives). These two Q&A sessions were provided in the last two weeks of the full project cycle of about 1 month.

According to the students' responses, the project Q&A sessions were demonstrated to be a smooth and effective communication approach outside the classroom. Additionally, there are a number of emails between students and the teaching staff as a complementary approach for the implementation of the project. Finally, the project report was due near the end of the semester of Fall 2010.

After all these efforts contributed by both students and teaching staff, all participating students completed the course project successfully. We also note that there was one team with a member short. In this case, a student assumed the role of two managers. The outcomes of the course project as well as the corresponding assessment will be presented in the following section.

Assessment and Results

Our assessment consists of the rubric-based scores from the instructor perspective and the pre- and post-surveys from the student perspective. First, let us present the outcomes from the instructor side. The rubric-based assessment of the project was on a 100-point scale. Out of 100 points, 54 points were assigned to three outcome item rubrics (18 points for each rubric), and 46 points were assigned to students' performances in terms of mathematical correctness, analysis insights, and general clarity of the project narratives.

Project Report Analysis

The project report contained the information regarding the project contents, the evolution of the project progress, and the contribution of each team member. The project report specifically addressed the following items.

- (i) The breakdown of primary contribution of each team member (contribution breakdown sheets).
- (ii) Each manager’s demonstrated leadership and responsibilities (objectives, actions, and solutions).
- (iii) The sequence of events for the project progress (e.g., project meetings and communication printouts).

For the evaluation of this project report, we utilized the rubrics of outcome items (d), (j), and (m) as shown in Tables 2, 3 and 4.

Table 2. Rubric for Criterion (d): An Ability to Function on a Multi-disciplinary Team

<i>Item</i>	Exemplary 5-6	Acceptable 3-4	Poor 1-2
<i>Knowledge and integration of concepts from other disciplines</i>	Demonstrates ability to grasp concepts from other disciplines and the ability to appropriately integrate those ideas into the design effort	Ability to grasp most concepts from other disciplines and integrate those ideas into the design with minor problems	Inability to grasp concepts from other disciplines and failure to integrate those ideas into the design
<i>Team dynamics</i>	Accepts individual responsibility within a team, communicates effectively with other team members, demonstrates commitment to the team effort	With some exceptions accepts individual responsibilities within a team, communicates effectively and demonstrates commitment to the team effort	Fails to complete individual responsibilities, poor communication with other team members, failure to participate in team efforts

<i>Organization</i>	Demonstrates ability to develop project plan and agenda for team meetings, and effectively adheres to the agenda, consistently maintains a design journal for team design efforts	With some exceptions develops good project plan, develops and adheres to meeting agenda, maintains a design journal for team design efforts	Fail to develop good project plan, does not develop or adheres to agenda, little effort to complete design journal
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Table 3. Rubric for Criterion (j): A Knowledge of Contemporary Issues

<i>Item</i>	Exemplary 5-6	Acceptable 3-4	Poor 1-2
<i>Understanding of Contemporary Industrial Engineering Issues</i>	Understands the contemporary industrial engineering challenges, solution tools and methods, and further trends	Some understanding of challenges and future trends	Little understanding of challenges or trends
<i>Understanding of Contemporary Economic and Business Issues</i>	Understands the contemporary economic and business challenges, solution tools and methods, and future trends	Some understanding of challenges and future trends	Little understanding of challenges or trends
<i>Understanding of Contemporary Environment and Energy Issues</i>	Understands the contemporary environmental and energy challenges, solution tools and methods, and future trends	Some understanding of challenges and future trends	Little understanding of challenges or trends

Table 4. Rubric for Criterion (m): An Ability to Provide Leadership in Multi-functional Team

<i>Item</i>	Exemplary 5-6	Acceptable 3-4	Poor 1-2
<i>Understand the human technical, and business of a multi-functional team</i>	Understand relationships and constraints involving the human, technical and business aspects	Some minor relationships or constraints missing	Some major relationships or constraints missing

<i>Show the way before or with other members of the team</i>	Manage resources well and finish on time of a project or a project phase. The outcome is plausible.	Manage resources well and finish on time of a project or a project phase. But key aspects of outcome are missing or incorrect	Manage resources poorly or can not finish on time of a project or a project phase.
<i>Understand the role of the leadership</i>	Determine the impact of leadership on the team and vice versa	Some aspects of the impact are missing or incomplete	Some major aspects are missing or incorrectly determined

In total, 59 students participated in this course project, including 51 IE majors and 8 non-IE majors (e.g., Business Administration majors). There were no non-IE-major-only teams. The means and variances for all the students are given as follows: (1) for outcome (d), the average score was 14.75, and the variance was 2.41; (2) for outcome (j), the average score was 17.19, and the variance was 1.92; (3) for outcome (m), the average score was 16.07, and the variance was 1.63. There were some differences among students in the same team due to various reasons such as not showing up for some of the team meetings.

The examination of the project report shows that the students in most cases followed the steps (suggested a priori by the instructor) well. For example, for the question of “at what tariff level should the board of managers decide to shut down the off-shore plant in China?”, first, the specific responsibility and objective of each manager were presented at the board of managers meeting. Next, the project leader in that phase of the question in the meeting led the discussion among the managers, coordinating the diverging opinions of the managers. Finally, the board of managers reaches a final concensus via some combination of competing and compromising. Meanwhile, the project report shows less collaboration with respect to the strategic problems regarding environmental issues. For example, some teams were unable to show their flexible decision making process as the environment parameters vary. This is possibly because the contemporary environmental issues (e.g., carbon footprint reduction) seem only indirectly related to the economic benefits. This perhaps results in a disadvantageous position of the environmental and energy manager during the competing and compromising process.

Student Surveys

Before the project was launched, a pre-project survey was conducted in the class, and 44 out of 59 students participated in the survey (Non-IE majors were excluded as the ABET accreditation issues were for IE majors; for Business majors, AACSB exists for their accreditation). Also, after the conclusion of the project, a post-project survey was conducted in the class, and 49 out of 59 students participated in the survey.

Three critical questions were asked in both the pre- and post-project survey:

“How well has your education in IE at ISU helped your ability to:

d. an ability to function on multidisciplinary teams

j. a knowledge of contemporary issues

m. an ability to provide leadership in multi-functional teams”

“1 = not at all, 5 = extremely well”

For the first question (d), the average response scores (variances) in pre- and post-project surveys were 3.91 (1.05) and 4.06 (0.71), respectively. For the second question (j), the average response scores (variances) in pre- and post-project surveys were 3.86 (0.77) and 4.04 (0.73), respectively. For the third question (m), the average response scores (variances) in pre- and post-project surveys were 3.95 (0.91) and 4.35 (0.68), respectively. The comparison between the pre- and post-project surveys is shown in Figure 2.

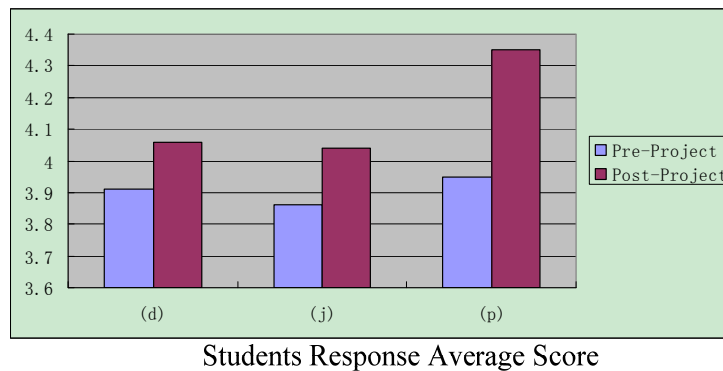


Figure 2. Comparison between Pre- and Post-Project Surveys

Furthermore, three additional questions were asked in the post-project survey:

“x. How helpful has this project been for increasing your ability described in (d)?”

“y. How helpful has this project been for increasing your ability described in (j)?”

“z. How helpful has this project been for increasing your ability described in (m)?”

“1 = not at all, 5 = extremely well”

For the first question (x), the average response score (variance) was 4.00 (0.78). For the second question (y), the average response score (variance) was 3.86 (0.79). For the third question (z), the average response score (variance) was 4.02 (0.77). The entire distribution of the responses is shown in Figure 3.

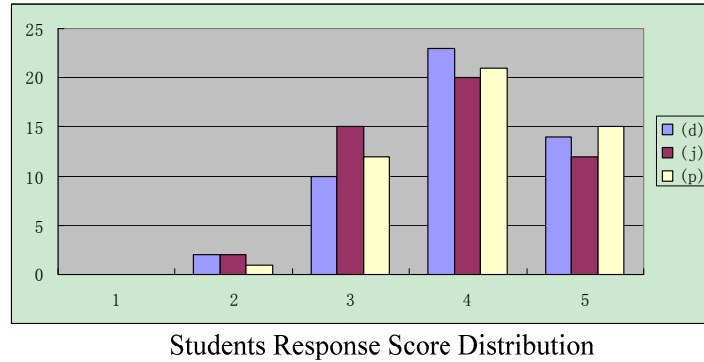


Figure 3. Post-Project Survey – Response Distribution

From these results, we find that the project was helpful for the IE majors to attain the stated three outcomes (at least from the student perspective). We believe that, perhaps the steps suggested a priori for the teamwork and leadership issues helped the students to demonstrate their abilities, and, at the least, helped them to become more aware of such skills they have.

Finally, in comparing the rubric results and the survey results, our findings are largely consistent with each other (or at least not in conflict). For example, the biggest improvement from student perspective was made in Outcome (m). This is supported by the fact that the average rubric score for Outcome (m) was 16.07 out of 18, which can be viewed as a high level of performance.

Concluding Remarks and Future Works

In this paper, we presented the motivation, description, as well as organization and management of a team-based global supply chain course project. This was followed by the assessment of the team effectiveness, leadership, and knowledge of contemporary issues (e.g., environment and energy) based on the project report evaluation by the teaching staff as well as pre- and post-project surveys. The evidence collected seemed to be positive in general. Students are not only able to produce multi-disciplinary solutions to this global supply chain company, but also able to demonstrate their leadership and teamwork skills.

Even though the general assessment of the surveys and the project report were positive, there were some points of improvement identified. For example, some students mentioned in written comments that the work was not divided equally among four managers in some phases. Also, based on this first-cut attempt, we believe that via continuous improvement efforts, the extent of improvement will be more reliably measured and demonstrated in the future. Finally, it would be desirable to involve students from foreign countries (e.g., China), so that a higher degree of realism will be added to this project.

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