

Interdisciplinary Application of Operations Management: An Educational Center

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Keywords

Abstract

The Center for Technological Innovation, Leadership and Entrepreneurship (CenTILE) is charged with promoting interdisciplinary education and research at a technological based university. The program began in 2001 with the sponsorship of two endowments. Since its inception it has provided a wide-variety of programs promoting interdisciplinary education. One key aspect is the CenTILE project course, allowing for hands-on experiential learning among engineering, business, and technology disciplines. The initial discussion will focus on CenTILE with the final portions of the paper focusing on the CenTILE project methodology, measurement and evaluation, and ideas for the future.

Introduction and CenTILE Overview

What is CenTILE?

The Center for Technological Innovation, Leadership and Entrepreneurship (CenTILE) is a recently established Center at Michigan Technological University (MTU), which resulted from a joint initiative by the School of Business and Economics, College of Engineering, and College of Sciences and Arts. CenTILE is charged with the responsibility of promoting interdisciplinary education and research at MTU. In addition, it will seek to develop cooperative initiatives across the campus aiming at advances in technological innovation, leadership, and entrepreneurship. The Center will be a catalyst in the conversion of technology into economic value to businesses in Michigan and throughout the nation.

Background Information

Currently, the CenTILE is sponsored via Michigan Tech Fund in the form of endowments: The Carnahan Endowed Chair in The Business of Technology and The Gates Family Foundation Endowed Distinguished Professorship in Entrepreneurship Studies. The Center has received a Coleman Foundation grant, which supports a joint project between the SBE and the College of Engineering.

Similar centers have been developed in several universities during last 20 years. Most of them are focused on entrepreneurship education with strong links to the business community. Business start-up projects are the most common subject of student and faculty research.

CenTILE Strategy

The CenTILE Strategy includes the vision, mission, goal, objectives, and programs to meet its overall intent.

Vision

CenTILE will position Michigan Tech as a leader in bringing technological innovation and entrepreneurship to the classroom and industry.

Curricula will integrate undergraduate and graduate education in business, engineering, and the sciences with the research and other entrepreneurial activities at the University.

Results of applied research, combining cutting-edge technology and the art of entrepreneurship, will provide industry and MTU students with a competitive edge in the global marketplace.

CenTILE Mission Statement

Integrate multi-disciplinary undergraduate and graduate education with research in business, engineering, and the sciences to advance innovation, leadership, and entrepreneurship. The Center will be a catalyst in the conversion of technology into economic value to businesses in Michigan and throughout the nation.

Objectives

There are several strategic objectives, and these include:

- CenTILE project program
- Seminars on business-start-up, intellectual property, patenting, and commercialization of technology
- Executive education programs
- Entrepreneur-in-residence programs
- Entrepreneurs and Inventors Club
- International interdisciplinary research (externally sponsored)
- Technological innovation research (NSF sponsored)
- Innovation assessment program

Interdisciplinary Methodology

A brief description of the project experience and the project objectives will be followed by the methodology that consists of application process, team formation, company solicitation and selection, project team presentation, measurement and evaluation, and continuous improvement.

Overview of Interdisciplinary Project Experience

Although CenTILE covers many areas of interdisciplinary activity, one of the most active and prevalent is the CenTILE project experience. The project experience brings together multiple disciplines in a semester long endeavor by focusing on solving a critical business issue. By utilizing teams with students from different engineering, business, and science disciplines, allows for an integrative learning experience.

CenTILE Project Objectives

The objectives of the project are to allow students to:

- Understand the practical applications of interdisciplinary projects.
- Gain a clear understanding of a systematic approach to solving business problems.
- Develop your problem solving, team building, and communication skills.
- Use knowledge and experience gained through other courses and work experience to develop a set of well thought out alternatives for actual companies.

Project Features

Michigan Tech's CenTILE Project features include:

- Small teams of students (5-6 per team)
- Interdisciplinary projects
- Accelerated and condensed projects
 - 15 week semester
 - 2 semester option
- Hands-on applied learning
- Less costly than Michigan Tech Enterprise program
- Two to three visits to your site per semester
- Virtual collaboration and development
- Less expensive than using consultants
- Project team guided by faculty with industry experience

Application Process and Team Formation

Students apply to participate in the CenTILE project program. The application process is a screening to ensure the students are truly interested and dedicated to participating on a project for an entire semester. Because the application (included in the Appendix) requires providing information and completing a few questions, it is a weeding out process for students who may not be willing to dedicate the necessary time to work in an independent credit earning situation.

The selection process is not based strictly on grade point average. Heavy weight is given to the responses to the questions for reasons for participating and contribution to career goals. Also, the selection of courses and grades received in those courses is given a lot of weight. An interesting side note, the students that have average grades have been the strongest contributors on past project teams.

Once the students are selected, they are able to chose the project they have the greatest interest. Part of soliciting students is based on their knowledge of prospective projects. It is critical to know in advance of the semester which projects will be available. It is also important to make sure there is a mix of different disciplines on the project. To date, students in business – accounting, marketing and management, civil engineering, and manufacturing/mechanical engineering have participated.

Company Solicitation and Selection

CenTILE projects are not free. There is a fee charged to companies utilizing student project teams. The co-director of CenTILE is responsible for soliciting companies interested in participating. Because of our rural location and the small size of companies, this limits the pool of available companies willing to participate. We have started contacting companies that are within 2-5 hours driving distances. Some of the project teams may be able to operate in a virtual environment and minimize the number of visits to the site location. This can be accomplished through video/audio conferences and project chat rooms.

Since the project inception in Fall semester 2002, there has been a total of nine projects either completed or in-progress. Spring 2004 has the largest number of concurrent projects running with three. We would like to offer this project experience to more students as it provides an experiential learning alternative to internships.

Project Team Preparation

The project team preparation is designed to enable each team to present itself professionally to the company. Some of the students may have career-related experience and have worked in a

professional setting. However, some students are not adequately prepared to contact the company and properly convey the purpose of the project. Since the initial contact with the company is through the instructor, a preliminary project description and broad objectives are given to the project team. This allows them to gain an initial understanding of what the company's desired results/outcome may be. It also gives students the opportunity to gather more information to develop a detailed project plan as a part of the course requirements.

Prior to the initial meeting with the company, training sessions are held with each team to discuss meeting skills, project management skills, consulting skills, and project reporting and presentation skills. Initial projects did not benefit from this training. After the initial projects were completed and feedback received from the participant companies, a set of training modules was developed and presented to the students during the first and second week of the semester. The faculty project advisor will attend the first meeting with the student team. The advisor does not attend subsequent meetings until the final presentation. This allows students the independence to meet with the client as the feel is necessary. Some teams chose to meet as frequently as once a week.

As a part of our quality management process, the faculty project advisor receives weekly status reports and reviews all deliverables prior to being presented to the client. This ensures that the client receives a high quality product.

Project Type

There are unlimited opportunities for student teams to assist your companies. Some of the possible projects and related majors include:

- Feasibility studies (business and engineering)
- Supply chain management (business, computer science, engineering)
- Lean manufacturing (business, computer science, engineering)
- Site evaluation and development (business and engineering)
- Operational assessment (all disciplines)
- Marketing/customer service (all disciplines)
- Accounting system identification (business and computer science)
- Cost estimating and economic evaluation (engineering and business)
- Information systems (business and computer science)
- Technology management (all disciplines)

These are a few of the possibilities and will consider other project opportunities.

Measurement and Evaluation Process

There are two aspects of performance measurement. There is a team-based performance evaluation form developed by the team to evaluate their entire contribution to the project effort.

Team-Based Performance Evaluation

This performance evaluation is unique to each team. A sample performance evaluation is included in the Appendix. The performance evaluation counts for twenty percent of their overall individual grades.

Client Evaluation

The client input and feedback is important to the continuing success of the project program. Each semester changes are made based on the feedback provided from clients. There are two

parts to the client evaluation: an evaluation form completed by the client and either telephone or face-to-face discussion. Both evaluations occur after the project is completed but prior to the end of the semester. The client evaluation counts for twenty percent of their overall individual grades.

A survey was developed to solicit feedback from participant companies regarding the CenTILE project. A five-point Likert scale was used with 5 denoting Strongly Agree and 1 denoting Strongly Disagree. A respondent could use NA. The survey results for the initial five project conducted during 2002-3 academic year are presented in Table 1.

<i>Survey Question</i>	<i>Average</i>	<i>Std. Dev.</i>
<i>Communication</i>		
1. The team acted as an effective intermediary between your organization and MTU/CenTILE.	5.00	0.00
2. The team provided enough advance notice to you and others regarding interviews for the project.	4.60	0.55
3. The team was clear and concise in their questioning during interviews	4.60	0.55
4. The team members were on time for meetings scheduled with your company.	4.60	0.55
<i>Meetings</i>		
5. The team was effective in organizing meetings	4.20	0.45
6. During those meetings, the team provided to you timely and appropriate information.	4.20	0.45
7. The team was well organized.	4.40	0.55
<i>Gathering Information</i>		
8. The team was prepared when they visited your organization.	4.20	0.45
9. The team demonstrated clear evidence of progress through the submission of periodic project status reports.	4.75	0.50
10. The team provided clear evaluation and analysis of sites visited.	4.80	0.45
11. The team thoroughly presented the strengths and weaknesses of each site.	4.75	0.50
<i>Quality of Report</i>		
12. The quality, timeliness and evolution of draft reports met your expectations.	4.25	0.50
13. The content and quality of the report met your expectations.	4.60	0.55
14. The information in the report helped you view this situation in a new light.	4.60	0.55
15. Overall, the report was very useful.	4.60	0.55
<i>Presentation</i>		
16. The group's final presentation demonstrated a clear understanding of the information and professionalism in its delivery.	4.75	0.50
17. The overall content of the presentation met your expectations.	4.75	0.50
<i>Overall</i>		
18. Overall, our company was satisfied with participating in the project.	4.60	0.55
19. Overall, the team acted in a professional manner.	5.00	0.00

Table 1: Survey Summary

Continuous Improvement

As a result of the feedback provided by students through end of the semester faculty evaluation and client feedback through surveys and interviews, to date the following changes have occurred:

- Developed initial training modules.
- Conducted initial training sessions during first two weeks of class.
- Changed the process for soliciting companies.
- Increased the focus on cross-learning between disciplines on the project. For example, asking a business student to develop a layout. Asking a non-business student to develop

and conduct surveys that may be typically conducted by business students.

Case Examples

The initial pilot projects were for a county road commission and a manufacturer of mobile equipment. The details of each of these projects are provided.

County Road Commission – Operational Assessment Project

A construction company and local road commission were the clients for this project. This relationship was unique because the team needed to simultaneously satisfy two clients with differing needs. This was the first joint project with these two entities. This was the first CenTILE project.

Problem statement: Because of county, state, and federal budget constraints, the road commission had reduced employment levels without significantly reducing workloads. The road commission receives pressure from taxpayers to provide the same level of services with fewer resources. Although studies of the operations have been conducted in the past, the current resource utilization of manpower, equipment, and facilities needed to be updated.

Project Description: The project objective was to conduct current situational analysis of the road commission current facilities including manpower, buildings, sites, and equipment. The results from this analysis will be used to determine subsequent phases. The major deliverable for the CenTILE project was a situational analysis report and included the following activities:

- Visit all road commission facilities and assess their current condition and assess the adequacy of facilities
- Develop an list of the facilities size
- Review relevant legal and governmental codes to assist with the assessment
- Review and assess current operational procedures (i.e., preventive maintenance, safety, inventory management, operations, etc.)
- Interview select supervisors and employees
- Review and assess operational records
- Review and assess position descriptions for accuracy and coverage
- Develop an equipment list and assess the current condition
- Observe the operations
- Compare the documents/records, observations, and procedures and practices to note any differences

The situational analysis report was presented to the road commissioners in December 2002 and led to the second study to develop a site plan.

Manufacturer of Mobile Equipment – Inventory Management

A producer of a variety of versatile, mobile equipment products provides assets for industries such as logging, steel, paper, construction, farming, road construction, mining, railroad, and public utilities.

Problem Statement: Inventory counts were not accurate, service parts in the warehouse were not easily located, and there was wasted resources trying to reconcile inventory and locate parts.

Project Description: As a part of the lean manufacturing implementation and continuous improvement, this location was evaluated using the 5S system to improve inventory management and warehouse organization. The major activities included:

- Review current inventory procedures
- Observe current inventory management practices

- Assess the current condition of the warehouse layout, shelving, and organization of spare parts
- Apply the 5S concepts to inventory management and warehouse
- Provide recommended improvements to minimize waste
- Implement warehouse management system by rearranging and grouping like parts
- Automate the spare parts inventory to identify quantity and location of the parts in the warehouse

The “Logistics of the Warehouse Using 5S System” report was presented to the client in December 2002.

Additional projects were completed during the Spring and Fall 2003 and are discussed below.

Village Project – Feasibility Study for a Golf Course

A Village was considering developing a golf course. The property is located on the shores of local lake and is situated close to the downtown area. There is a public marina and boat landing nearby.

Problem Statement: Is it feasible to develop a golf course on remediated Superfund land?

Project Description: The major activity for the CenTILE project was a general feasibility study that included:

- Develop overview of the community
- Define the market area
- Conduct competitive analysis
- Conduct demographic study of the area
- Conduct site analysis
- Project membership
- Project demand
- Provide recommendations for funding the project

The Village Council, business groups, local land owners, and other interested investors have demonstrated strong support for the proposed golf course project, and worked very well with the student project team.

Status Update: Discussions are ongoing with engineering, construction, and EPA officials to finalize plans for the course. The course is unique in that it is being developed on a remediated Superfund site.

County Road Commission – Site Development/Preparation Plan Project

A construction company and local road commission are the clients for this project. This relationship was unique because the team needed to simultaneously satisfy two clients with differing needs. This was the second joint project with these two entities.

Problem Statement: The road commission sought to identify the future location of their central operations that best meets their long-term needs. The road commission’s central office is located on the waterfront in a small community. Because of environmental impact concerns and the desire of the National Historical Park Service to utilize the land, a more feasible location is necessary.

Project Description: The major deliverable for the project was a site development plan for another road commission location. This included:

- Review situational analysis completed prior to the inception of this project

- Determine the building needs
- Evaluate existing buildings
- Determine equipment requirements (i.e., cranes, welding, etc.)
- Conduct detailed site analysis
- Understand structural issues
- Identify health and environmental impact issues
- Evaluate land conditions, including low areas and drainage considerations
- Provide a detail site development plan with drawings and specifications

Because of time limitations, the team was unable to complete a development plan for the current site.

A County – Lodge Facility Accounting System

A county owns and operates a Lodge in small, rural, former mining community. The Lodge has a dining facility, bar, golf course, and cottages. It is a seasonal business, open from mid-May through mid-October.

Problem Statement: At present, the Lodge uses a cash method of accounting with no segmentation of the different areas of business. The present accounting system does not provide useful information to management. The Lodge has expressed a need for a new accounting system. Once a new system is designed, it will be to restate past operating years and an appropriate analysis of past business results will take place. In addition, the Lodge is seeking recommendations on future business strategy. Of particular interest is enhancing operating results during non-peak times (i.e., May and June).

Project Description: Those participating in this CenTILE project have been asked to do the following:

- Visit the Lodge to become acquainted with the business operation
- Identify accounting issues pertinent to the Lodge
- Create suitable profit and cost centers
- Develop a management accounting system
- Apply the developed system to the past 3 years of operations
- Calculate variances and perform a differential analysis
- Calculate break-even and target profit figures
- Make recommendations on revenue enhancement and cost control
- Make recommendations on future uses of capital

Students participating in this project are responsible for a complete re-design of the accounting system, review of past operating results, and development of a business strategy for the Lodge.

Lessons Learned from Past Project

The projects have been successful and both the students and client companies have found it to be a valuable learning experience. Several recommendations and suggestions for future teams were provided by students who completed projects. These lessons learned include:

- Provide more lead times on deadlines when providing review documents to advisor
- Realize deadlines may change and allow some flexibility in your project plan
- Encourage document and team organization from inception of the project
- Request teams have a set time to meet at least 2-4 hours per week
- Develop clear project objectives and expectations from the beginning, minimize changes

- Take notes during interviews that are more detailed than class notes as there is no book to reference and the client may be annoyed if you ask the same questions more than once

Conclusion

This valuable learning experience has provided for hands-on, interdisciplinary education. Engineering students participating in the projects have learned from peers in business about different tools and techniques. Business students have applied some basic engineering concepts and methods with the assistance of their peer engineering students. In addition to applying interdisciplinary tools, it is important to recognize that individual students typically select majors that may be compatible with their personalities. Because students are coming from different disciplines and perspectives, it allowed the teams to gain a greater understanding and appreciation for individual differences and respect for other opinions. All in all the CenTILE project experience has broadened the horizons of students, allowing for interdisciplinary experiential learning.

APPENDIX**BA 4950 CenTILE Project
Project Team Member Application**

<i>Name: Last, First, Middle</i>
<i>Student ID:</i>
<i>Class Rank:</i>
<i>Major and Concentration:</i>
<i>Current GPA:</i>
<i>Present Address (Street, City, State, Zip):</i>
<i>Permanent Address:</i>

<i>Education</i>	<i>Dates: From - To</i>	<i>Degree Expected</i>	<i>Graduation Date</i>	<i>Academic Major</i>	<i>Grade Point Average</i>
Michigan Technological University					

Please list of characteristics, academic and personal, that you believe are major strengths in participating in a project environment.

Please identify potential areas where you can improve to enable you to better participate in a project environment.

Please list 10 courses and grade that you believe will contribute to the success of your participation in the CenTILE Project.

Course # and Name	Grade	Course # and Name	Grade

ATTACH:

Please include a copy of your most recent resume.

Please develop a one-page statement. In this statement discuss how you feel you can contribute to the success of the CenTILE project, what role you would like to play, and how it will benefit your career.

APPENDIX

BA 4950 CenTILE Projects

Group Project Team Evaluation Forms

Throughout the semester you have been working in teams to solve a business problem at a local business. As a part of your grade, you are being asked to evaluate yourself and your team members. Please evaluate yourself and each team member for the following characteristics. Please circle one number for each characteristic. Use the following scale:

5 - Strongly agree, 4 - Agree, 3 - Neutral, 2 - Disagree, 1 - Strongly disagree

Attendance: Attends meetings regularly.

- | | | | | | |
|----|---|---|---|---|---|
| 1. | 5 | 4 | 3 | 2 | 1 |
| 2. | 5 | 4 | 3 | 2 | 1 |
| 3. | 5 | 4 | 3 | 2 | 1 |

Attitude: Generally has a positive and enthusiastic attitude, is cooperative, motivates the team, and works well with team members.

- | | | | | | |
|----|---|---|---|---|---|
| 1. | 5 | 4 | 3 | 2 | 1 |
| 2. | 5 | 4 | 3 | 2 | 1 |
| 3. | 5 | 4 | 3 | 2 | 1 |

Communication: Effectively communicates within the group and with the client at all times. Notifies group members when there are unforeseen circumstances.

- | | | | | | |
|----|---|---|---|---|---|
| 1. | 5 | 4 | 3 | 2 | 1 |
| 2. | 5 | 4 | 3 | 2 | 1 |
| 3. | 5 | 4 | 3 | 2 | 1 |

Contribution and Effort: Contributes to the team as a group effort, accepts input from others, is a hard worker and focused on the needs of the project and case studies. Communicates with team members in a timely manner.

- | | | | | | |
|----|---|---|---|---|---|
| 1. | 5 | 4 | 3 | 2 | 1 |
| 2. | 5 | 4 | 3 | 2 | 1 |
| 3. | 5 | 4 | 3 | 2 | 1 |

Creativity: Comes up with ideas that others did not. Goes beyond basic requirements.

- | | | | | | |
|----|---|---|---|---|---|
| 1. | 5 | 4 | 3 | 2 | 1 |
| 2. | 5 | 4 | 3 | 2 | 1 |
| 3. | 5 | 4 | 3 | 2 | 1 |

Flexibility: Tries hard to work with other people's schedules. Is willing to work whenever possible.

- | | | | | | |
|----|---|---|---|---|---|
| 1. | 5 | 4 | 3 | 2 | 1 |
| 2. | 5 | 4 | 3 | 2 | 1 |
| 3. | 5 | 4 | 3 | 2 | 1 |

People Skills/Professionalism: Works well with our clients and acts professionally.

- | | | | | | |
|----|---|---|---|---|---|
| 1. | 5 | 4 | 3 | 2 | 1 |
| 2. | 5 | 4 | 3 | 2 | 1 |
| 3. | 5 | 4 | 3 | 2 | 1 |

Preparation and Participation. Individual is prepared for all team meetings and participates regularly. Team member is reliable and submits quality work to team. Knowledgeable and well prepared.

- | | | | | | |
|----|---|---|---|---|---|
| 1. | 5 | 4 | 3 | 2 | 1 |
| 2. | 5 | 4 | 3 | 2 | 1 |
| 3. | 5 | 4 | 3 | 2 | 1 |

Resourceful: Finds out information that may have been overlooked by other group members.

- | | | | | | |
|----|---|---|---|---|---|
| 1. | 5 | 4 | 3 | 2 | 1 |
| 2. | 5 | 4 | 3 | 2 | 1 |
| 3. | 5 | 4 | 3 | 2 | 1 |

Timeliness: On time for all meetings, appointments, and submission of assignments.

- | | | | | | |
|----|---|---|---|---|---|
| 1. | 5 | 4 | 3 | 2 | 1 |
| 2. | 5 | 4 | 3 | 2 | 1 |
| 3. | 5 | 4 | 3 | 2 | 1 |

Total: Please arrive at a total for each of the members of your group including yourself. (Maximum of 50 points)

- | |
|----|
| 1. |
| 2. |
| 3. |

PLEASE IDENTIFY MAJOR STRENGTHS FOR EACH TEAM MEMBER.

PLEASE IDENTIFY AREAS OF IMPROVEMENT FOR EACH TEAM MEMBER.

COMMENTS: Please place all comments on the back. Your responses will be kept confidential.