Corporate Assessment of Strategic Issues in Technology and Management Education

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Abstract

Colleges and universities strive to prepare graduates for the demands of a technology-infused business world where familiarity with both engineering and management skills is necessary. Bucknell’s Institute for Leadership in Technology and Management is an example of a program created for that purpose. The structure and themes of the ILTM program were devised to meet the needs of industry; however, since its founding a decade ago, the business world has continued to evolve in its technologies and purposes. Assessment and improvement of the ILTM program, and others like it, are needed to ensure that graduates are truly meeting the needs of employers.

The purpose of this study will be to revisit the foundation of ILTM and determine the continuing relevance of its themes and structure in today’s business world. Initial effort was made at the time of founding to consult business leaders, so this study will return to that concept by surveying ILTM graduates now working in industry along with middle managers and executives who can give insight into the current demands for engineering and management graduates. The results of the survey, which includes both quantitative and qualitative responses, is compared to previously published rankings of desirable skills for graduates.

1.0 Introduction

Today the workplace is dependent on technology for everything from day-to-day communication to the actual manufacturing of a product. As a result, employers expect graduates to have familiarity with both the engineering/technology and business management sides of the business world. In order to obtain and excel in managerial positions, graduates must have a firm understanding of the interactions between technology and management, and how their interaction affects business decisions. According to a survey conducted by the Engineers Leadership Foundation and the Foundation for Professional Practice of almost two hundred senior engineering managers and leaders, engineering knowledge is essential, but leadership positions can be attained earlier if engineering students are exposed to management, public speaking, and other non-engineering coursework. The most highly recommended courses beyond an engineering curriculum included business management, public speaking, and marketing. In addition to taking courses, the professionals surveyed suggested involvement in activities like sports, internships, volunteering, and clubs to improve interpersonal skills.¹ The same can be
said for management majors – a well-rounded education both inside and outside of the classroom is necessary to succeed in a technology-infused business world. Any career involves the life-long learning and application of not only technical skills and theoretical knowledge, but also “people skills,” written and oral communication skills, and teambuilding skills.

Colleges and universities strive to prepare graduates for the demands of a technology-infused business world where familiarity with both engineering and management skills is necessary. In recent years, institutions of higher learning have made changes in curricula and have developed a variety of specialized programs in order to achieve that goal. These educational opportunities can be classified into several categories: engineering management, systems engineering, engineering entrepreneurship, and leadership, internship, and other multi-disciplinary programs. Most of these programs are designed to introduce engineers to the business world through courses, project teams, and interaction with business enterprises and business leaders. Most schools also offer minors or individual courses designed to introduce students of all majors to technology and its impact on business. Overall, schools try to offer a variety of courses and extracurricular activities that allow students to gain a well-rounded education. Emphasis has also been placed on group projects or in-class group work to prepare students to work effectively on teams.

One particular example is Bucknell University’s Institute for Leadership in Technology and Management (ILTM). ILTM offers an intensive two-summer program for twenty students from engineering, management, and accounting that combines theory and real-life experience. The first portion of the program is a six-week on-campus session during the summer after students complete their sophomore year. During this session, students are introduced to issues such as globalization, ethics, communication skills, critical thinking, teamwork, and leadership through in-classroom case studies and discussions, field trips, and a group project. The second portion of the program is an off-campus, minimum ten week, paid internship. The internship program was installed in response to companies’ desires to hire graduates with actual exposure to industry practices. The experience gives students exposure to every day planning and problem-solving activities in the organization and puts them in contact with managerial staff in the organization. The structure and themes of the ILTM program were devised to meet the needs of industry; however, since its founding a decade ago, the business world has continued to evolve in its technologies and purposes. In order to meet the changing needs of industry, the ILTM program and others like it must be continually assessed and improved.

External assessment of the ILTM program, and engineering/management education in general, by those who have participated in the program and by those who can objectively assess education of engineering and management students is necessary to ensure that ILTM is still fulfilling its foundational purpose to prepare students for successful careers that incorporate business and technological principles. The assessment discussed in this paper was achieved by separately surveying former ILTM students and corporate leaders in the business community. The ILTM graduates not only provided positive feedback on the program’s effectiveness in preparing them for the work world but also offered suggestions for updating its themes and format. Also, they offered an interpretation of employers’ expectations from the viewpoint of recent graduates. The corporate respondents represented the opinions of more senior members of the business community, and provided their insights into what is expected of college graduates.
entering technology-dependent fields as well as an assessment of how well colleges and universities are preparing engineering and management graduates. The responses to the surveys provided guidance for changes that can be made in higher education (and ILTM specifically) by both students and educators.

2.0 Employer Expectations

In the current economic climate, it is even more important for new graduates to have an edge over their competition. According to the National Association of Colleges and Employers (NACE), there is a slightly positive outlook on overall projections for hiring of new college graduates. (NACE’s annual Job Outlook is a forecast of the job market for new graduates based on a survey of the organization’s employer members. The 2004 fall edition of the survey is based on responses from 360 members representing service sector employers, manufacturers, government and nonprofit employers, and other employers.) Results of the survey predict an overall increase of 12.7 percent in new hires for 2003-04 as compared to last year, with the largest increase in hiring forecasted in the service sector. That would be the first increase in college hiring since 2001. Despite the positive outlook, over half of the employers still rated the overall job market for new graduates as only fair, indicating that the market is still quite competitive. And the positive outlook does not mean that job offers will equal the number of candidates. As for which graduates will be most in demand this year, the list is consistent with previous years: engineering, business, and computer-related majors will be targeted at the bachelor’s degree level.

Considering the competitive job market, the obvious question is what are potential employers looking for in candidates. According to the NACE survey, desired characteristics of an ideal candidate have not varied greatly from year to year. Topping the list of important qualities and skills is verbal and written communication skills, honesty, interpersonal and teamwork skills, motivation/initiative and a strong work ethic, and analytical skills. Although GPA ranked near the bottom, employers indicated that it is commonly used to screen candidates. Employers also placed emphasis on the importance of prior work experience, citing internship and relevant work experience as the most important. For new graduates, internships or co-ops are the best source of relevant work experience – in fact, employers named internship programs as their most effective recruiting tool. The areas in which new graduates were judged to be lacking overall were communication skills, maturity and work ethic, commitment to the organization, and business etiquette. Furthermore, many graduates tend to have an unrealistic view of the workplace. Overall, almost two-thirds of respondents agreed that college graduates were well prepared for employment.

Once in the workforce, it is necessary to keep a competitive edge in order to advance to managerial positions. In the current economy, being up-to-date with the rapid pace of technological developments is important for maintaining employment, but when it comes to promotions additional considerations must be made. This dilemma is especially relevant to engineering industries, where there has been a trend of nonengineers landing the management positions that are best suited for qualified engineers. The strong technical background from engineering is important, but so are the management and leadership skills that employers look
When moving to a managerial position, engineers in particular have difficulty making the adjustment from more objective technological decision-making to the more subjective decision-making required in business. Engineers are trained to solve technical problems by defining the problem and then applying straightforward technical principles to develop a solution. Managers must make decisions by evaluating the possible impacts of various choices, a process that requires experience rather than just theoretical knowledge. Succeeding in business requires a different mindset than solving a technical problem.

Employers look for potential managers who exhibit strong leadership skills in a project-team setting, including the ability to adapt to change and using effective interpersonal skills. An essential part of any business is proper functioning of interdepartmental, multi-disciplinary teams in which communicating is key. The team must stay focused on their goals, and tasks must be delegated in a manner that allows team members to utilize their skill sets to achieve those goals. Managers especially spend time talking to people in their own department and in other departments; being able to clearly convey a message through both written and oral communication is a necessity (for any position). In addition, it is imperative to understand the technological capabilities related to a project and then be able to explain the feasibility of a project based on the technical limitations. A firm grasp of how technology relates to business decisions is essential for a successful project.

3.0 Survey

The purpose of the survey conducted for this study was to obtain feedback from individuals in industry about the expectations for graduates and to learn what can be done to better prepare them for successful careers. A more specific goal was to revisit the foundation of the ILTM in order to determine the continuing relevance of its themes and structure in today’s business world. Initial efforts were made at the time of its founding to consult business leaders, so this study returned to that concept by surveying ILTM graduates now working in industry along with middle managers and senior executives who can give insight into the current demands for engineering and management graduates.

The ILTM graduates surveyed represent both engineering and business-related majors who are now employed in entry or mid-level engineering or managerial positions in a variety of industries, working for example as an associate in investment banking/business analysis, an associate at a law firm, or a senior level design engineer. A total of eleven relatively recent Bucknell graduates, representing graduating classes of 1995 through 2003 provided detailed responses. Ten responses were also received from middle management and senior executives, not necessarily Bucknell graduates, from various industries – including the Senior Vice President of Human Resources for a leading developer of information technologies and the CIO for a division of a leading global financial services firm. Many of the corporate participants experienced the evolution of the business world first hand, having been in the workforce for fifteen to forty years. All companies represented have had some interaction with the ILTM program, through projects, lectures, field trips, or internships. Appendix A contains a descriptive table of the participant pool – the position, company description, and experience level of each respondent is provided.
Two sets of survey questions were developed, one for ILTM graduates and one for mid-level managers and senior executives. Questions were both quantitative and qualitative and were formulated carefully with the help of Bucknell faculty members and staff who were acquainted with both the corporate world and the ILTM program. Quantitative questions asked participants to rate their answers on a 10-point scale, although after conducting the survey it was determined that a 5-point scale may have been easier to assess and could be used in future assessments. Questions for ILTM graduates were specifically focused on the appropriateness of themes, such as leadership, globalization, communication skills, and critical thinking, in obtaining a job and advancing in industry. Managers and executives were asked to define and rate skills, thought processes, etc. that are necessary to participate and succeed in business today. They were also given the opportunity to rate and comment on the general preparation of engineering and management graduates to enter the work force. The questions from both surveys can be seen in Figure 1.

### ILTM Survey (Mid-Level Managers and Senior Executives)

1. What is your current job title?
2. Are there ILTM graduates who have or currently work for you? Please comment on their preparation for entering your company and their subsequent progress.
3. What do employers expect of today’s engineering and management graduates (for both fields and for each field individually)? That is, what skills, concepts and thinking abilities are most valuable?
4. Further, what is expected of top graduates in those fields? What separates “fast-trackers” from everyone else?
5. On a scale of 1-10 (1 being not at all, 10 being perfectly), how well are colleges preparing engineering and management students to deal with real-world problems and to be successful in their careers?
6. In a program such as ILTM, what is the relative importance of special tools and skills (ex. GIS), critical thinking, knowledge about specific industries, and practice with interpersonal skills? Please rank and provide explanations or additional comments.

### ILTM Survey (ILTM Graduates)

1. How would you describe your current position - Very Senior Executive, Senior Executive, Middle Level Manager, Entry Level? What are your main responsibilities?
2. On a scale of 1-10 (1 being poor, 10 being excellent), how well has the program fulfilled for you the purpose that it was created for – to prepare students for a workplace that integrates business and engineering principles? Please explain.
3. Which portion(s) of the program (lectures, projects, internship, etc.) did you find most beneficial and why?
4. On a scale of 1-10 (1 being poor, 10 being excellent), how appropriate were the ILTM themes (leadership, ethics, management, technology, globalization, etc.) when you participated in the program? Should the same themes be emphasized today? Are there themes that should be added?
5. On a scale of 1-10 (1 being not at all, 10 being very), how important was ILTM in helping you in finding a job after graduation? Has it helped you continue to advance (please rank again)? If so, how?
6. What do employers expect of today’s engineering and management graduates (i.e., what skills, concepts, and thinking abilities are most valuable)?
7. Which skills, concepts, and ways of thinking associated with ILTM do you find most useful in your profession?
8. Given your educational and professional experiences, how should ILTM evolve in future years?
9. Have you been involved with ILTM since you graduated from Bucknell?

Figure 1: Survey Questions
Survey Results (Mid-Level Managers and Senior Executives)

The respondents of the corporate survey were generally pleased with the preparedness of new graduates to enter the workforce, but cited several areas in which graduates could be strengthened. When asked what employers expect of engineering and management graduates, the responses were consistent with the qualities and skills that ranked highest in the NACE survey. Problem-solving/critical thinking, communication/interpersonal skills, teamwork skills, and drive were all frequent responses. In addition, respondents stressed the importance of technical competence and decision-making. The founder of an internet-based financial organization described the concept of drive or passion as “a willingness to do whatever it takes, whether that be doing a job that is outside of their area, lower than their skills level, or being flexible to move into a different role/project/initiative quickly.”

There was some distinction made between the majors, because the nature of jobs pursued by engineering and business majors differ. Executives from a global supplier of micro-electronics for the defense industry, which does not participate in very much “pure research,” stated interest in engineering graduates “who can apply those [engineering] skills in a business environment, so some knowledge of business principles is important.” On the other hand, management graduates are not expected to have a grasp of pure engineering knowledge, though they should be able to “apply systems thinking and have the ability to think through and plan work with much the same rigor as an engineer would.”

In addressing an area of weakness, the CIO of Treasury and Security Services for a leading global financial services firm stated that graduates need to be more prepared to face real-life problems. That is, once a student leaves the university, he or she “must know that they aren’t case studies anymore because once the presentation has been made, it isn’t over – either you make money or you lose it. Graduates must be prepared to plan, build, and operate.” In order to prepare for the realities of the work world, students must obtain practical experience either through internships and co-ops or through classroom interaction with experienced workers.

Building on the previous question, the corporate representatives were asked to describe what differentiates top graduates, and the general response was simply an overall stronger skill set than other graduates. More specifically, top candidates are able to work effectively on a team, are passionate about their projects, customers, etc., exhibit strong leadership and communication skills, and display above average competence in their field (i.e., strong GPA). The Manager of Campus Relations for a world-wide technology, manufacturing, and services conglomerate described top graduates as “passionately focused on driving customer success...they act in a boundaryless fashion, always search for and apply the best ideas regardless of their source.” Along the same lines, the University Relations Manager of a global supplier of micro-electronics for the defense industry views top graduates as those individuals “who will be self-motivated, have a passion for excellence and success, have the ability to successfully negotiate and interact with peers and management, and view difficult situations as challenges rather than obstacles.” In short, graduates on the fast track strive to go above and beyond what is required of their job.

Considering what employers expect of job candidates, are colleges and universities providing students with a well-rounded education in order to meet those expectations? The overall
response was that today colleges are doing a good job (eight out of ten respondents provided a numerical score, with an average ranking of 7.4, a high of nine, and a low of six) of preparing students to enter the work force, but that there were still definite areas for improvement. For example, a Financial Accounting Manager for a major manufacturer and service provider for health care products described the deficiency as “students need to be able to better relate what they learn in class to potential real world issues or challenges.” One respondent suggested that as a solution to that problem that colleges should invite “street-side people in to talk to students about the voice of the customers” and give students the opportunity to learn from others’ experiences, not just from textbooks. Internships and co-ops, begun as early as possible, would be another source of real world experience before graduation.

Colleges and universities have been trying in recent years to improve preparation, so respondents were asked to determine the most important concepts that programs (like ILTM) should focus on. Overall, critical thinking/decision-making and effective interpersonal skills were considered the most important concepts. It was also determined that knowledge of a particular industry and mastery of special tools and skills were important but could be acquired on the job. A successful program was described as one in which students are “learning critical thinking and specific skills by examining real-world business cases and issues, ideally in a manner that forces students to work together in groups, present their findings, work against deadlines, etc.”

A few themes (teamwork, communication, systems thinking) showed up repeatedly as answers to questions, which can be attributed to their importance in obtaining and maintaining a job. As far as teamwork is concerned, the distinction must be made between simply working together and actually being a team. A team is not a group of individuals who work independently and then combine their solutions into a presentation, but rather individuals lending their own skills and points-of-view to defining a problem, developing a plan of action, and executing a solution. An appropriate definition of a team is “a distinguishable set of two or more individuals who interact dynamically, interdependently and adaptively to achieve specified, shared and valued objectives.”

Directly related to successful teamwork is effective verbal and written communication, between team members and between the team and interested parties. The necessity of effectively conveying one’s ideas was explained by the University Relations Manager of a major supplier for the defense industry: “So often, good ideas or good talent get lost or dismissed because of the inability of individuals to effectively communicate…If critical thinking helps create the good ideas, then superior interpersonal skills help to drive and sell those ideas to success.”

The third theme, which was not always named specifically, was systems thinking – the ability to integrate information from various sources and understand the impact of a decision on the whole system. In addressing critical thinking, one respondent stated that leaders must be able to “look at problems and challenges, objectively analyze facts, apply those facts in the context of the situation/company/industry, and consider the various impacts and potential outcomes of decisions…the ability to use critical thinking and a holistic approach, becomes the stage setter for all future success.” The decision-making process must involve looking at the problem from all sides – technical, financial, etc.
5.0 Survey Results (ILTM Graduates)

The survey designed for former participants of the ILTM program contained questions similar to those asked of corporate respondents as well as questions more specific to ILTM. The intention of this was to gauge how well the program addressed employers’ needs and if participants felt more prepared for their career as a result of the program. The ILTM graduates, like the mid-level managers and senior executives, were asked to define the skills and abilities that employers expect of college graduates. These participants brought different perspectives than the more senior corporate respondents, having been members of the workforce for only one to ten years. Consistent with corporate responses and the NACE survey, initiative, drive or work ethic, and teaming skills were frequent responses. A display of genuine interest in the company/project (through asking questions, staying current on industry-related happenings, etc.) is a concept that was not included in the NACE survey but was mentioned by several respondents. Oral and written communication and critical thinking/problem-solving were also listed as important abilities, but not with as much frequency. The lower emphasis placed on these areas was surprising but may be due to the benefits graduates have obtained from recent changes in higher education and from participation in the ILTM program, opportunities which were not available to the senior corporate respondents during their college careers.

Recognizing what employers are looking for, respondents were then asked which ILTM-related concepts they found most useful in their professional careers. A variety of answers were given, but the most frequent was leadership in a large project, ethics, the ability to “think outside the box” in solving a problem, and understanding the role of technology in decision-making. An interesting response was the importance of current event connections – an ’03 graduate highlighted the fact that participation in ILTM contributed to “feeling more informed about critical national and world issues than I have at any other point in my life” and that “the examination of these issues in conjunction with their relevance to program themes is invaluable.” The idea of “doing whatever it takes,” which was emphasized in the previous survey responses from more senior individuals, was also expressed by an ’03 graduate who said “in ILTM I learned to go above and beyond the call of duty – when you think you are prepared, prepare more; when you think you have uncovered all of the information, dig deeper; when you have no more questions to ask, brainstorm some more.”

Although the other survey questions addressed the respondents’ participation in the ILTM program, the suggestions made can be applied universally to engineering/management education. Participants were first asked to rate how well the program prepared them for a workplace that integrates business and engineering principles. The ratings from the ten participants who provided a rank ranged from seven to ten with half of the respondents awarding a nine or better (the average rating was 8.7). One participant declined to provide a rating, citing that their workplace did not integrate business and engineering principles. In support of their ratings, respondents explained that ILTM was a solid introduction to material that they would not experience in their normal engineering or management curriculums and that the opportunities outside of the classroom (project management, internships) were very beneficial. Another question asked the ILTM graduates to rate the appropriateness of the ILTM themes (leadership, ethics, management, technology, globalization, etc.) and again the respondents gave a positive response (ten out of 11 provided numerical ranks) – all ratings were seven or higher, and over
half were nine or higher with a mean of 8.8. Suggestions for improving the themes included stressing written communication more (“being able to summarize thoughts to a senior audience succinctly”) and focusing less on globalization specifically but more on ethics (as well as pressures placed on managers by regulatory commissions).

The ILTM program combines many different methods of education (including case studies, field trips, project work, team-based learning, mentoring, traditional lectures and discussions, etc.) and when asked which portions of the program were the most beneficial, every facet was mentioned at least once. Overall, the project/group presentation (which incorporates both team work and communication skills) and the lectures from outside speakers were deemed the most beneficial parts. A ’00 graduate described the group project as the “lynch pin” of the program, providing participants with “real-life experience on an actual business case in a restricted time period.” A ’95 graduate admitted that while the group work was the most frustrating part, it was the most beneficial in the long run because it “forced us to integrate the principles we were learning into a real life example.” Another ’95 graduate found the lectures most beneficial “because it struck a desire for continuous learning in business and leadership.” An interesting comment from a ’99 graduate was that although the lectures were most enjoyable at the time, looking back “the interaction with top caliber students from other disciplines forced me to expand my usual technical methodology of decision making” which has helped him throughout his career.

Another goal of the ILTM program is to provide students with the tools to find a job after graduation. When asked how important the program was in that aspect, the ratings from the ten out of the eleven interviewees ranged from three to ten; however, half of the respondents gave a rating of ten and the mean response was 8.2. Favorable responses included that the internship led directly to full-time employment and that discussing ILTM experiences was beneficial in the interview process. One graduate who gave a low rating stated that ILTM “was not concerned with helping students obtain full-time jobs,” but also admitted to using another resource (the Career Development Center) rather than seeking help from ILTM. The other moderate rating (five) came from a ’99 graduate who stated that he was recruited mainly based on GPA, but that he used his business experiences from ILTM to obtain the position he wanted.

While ILTM graduates seemed pleased with their experiences in the program overall, as with any program there is room for improvement. A common recommendation, and one that is being considered by the ILTM coordinators and Bucknell administration, is to extend the learning experience of the six-week on-campus portion beyond the summer to the regular academic year through additional classes or a minor. In light of the recent string of corporate scandals, respondents suggested focusing more on ethics and integrity, which could be achieved through additional case studies. Other suggestions were made to include topics on organizing and conducting effective meetings and to incorporate more debate.

6.0 Applying Results

Based on the results from both the NACE survey and the responses to the corporate survey, it appears that colleges and universities are preparing students quite well for demanding careers.
This positive opinion is due in large part to the trend in the education of engineering and management students of incorporating team projects and presentations (written reports, PowerPoint presentations, etc.) whenever possible, the goal being the combination of working in teams and developing better communication skills. The natures of the projects typically require some use of critical thinking and of course base knowledge from the students’ majors.

Employers deemed all of those elements important. However, there are not nearly as many opportunities for students to work in multi-disciplinary teams as both employers and students would like, which is important in appreciating the various factors (both technological and business considerations) affecting complex decisions.

ILTM strives to build on the use of multi-disciplinary teamwork in order to give students a holistic view of real-world problems and the decision-making process. This is achieved through the project portion of the program, which brings students from engineering and business majors together to solve a problem faced by a real company. Furthermore, students must use their communication skills to not only develop a solution as a team, but also to present their suggestions to the sponsoring company. Other areas of the program focus on theoretical knowledge (lectures), a realistic view of the work world (field trips), and practical hands-on experience (internship). The program seems to touch on all of the skill sets that employers value.

However, like any educational tool, the ILTM program needs to be continuously refined. In the decade since ILTM was instituted, there have been notable changes in the business world, and the program must change to reflect those changes. Today, globalization is often an assumed aspect of business, with many companies having plants or offices overseas. It is still important of course to understand the dynamic of running a multinational corporation and serving foreign clients, but the way that the topic is covered needs to be updated, as several ILTM graduates suggested. Other topics have become more prominent – over the past few years, with the string of corporate scandals and greater focus on regulatory agencies, ethics has become a more significant discussion point than it was ten years ago. As such, its treatment in the ILTM program should be more pronounced, possibly through the addition of more case studies. ILTM students also suggested that the program should be expanded to not only strengthen the experience of participants, but also to introduce similar topics to other students. However, it can be noted that no one suggested switching to a completely different format, like a minor program. That can probably be attributed to the benefits of the program – an intense experience with other highly motivated students and interaction with executives – which would not be possible with a typical classroom format. The overall correlation between senior corporate and graduate responses and the positive feedback from the former participants suggests that the ILTM program is fulfilling its purpose.

The question now faced is what can students do to meet employers’ expectations? The answer was summed up by the Human Resources Business Partner and Associate Manager of a major pharmaceutical firm who said “once they [graduates] have competence, then interpersonal skills and leadership attributes become a deciding factor for hire.” So first of all, students should try to take a variety of courses, like introductory engineering courses for business majors or vice versa, in order to develop a more holistic approach to problem solving. Becoming involved outside of the classroom in research, a club, a sport, a relevant internship, etc. shows motivation and initiative – important traits for any leader to have. Probably the most important things any
student can do when looking for a job is to thoroughly prepare for the interview and be able to clearly communicate intangible qualities like drive, passion, and leadership potential.

7.0 Conclusions

Although the survey incurred certain limitations (the qualitative form of many of the questions made them difficult to analyze and the number of respondents was relatively low), the study effectively gave an impression of what employers are looking for and offered some insight into how both educators and students can better meet those expectations. The responsibility is shared – educators offer opportunities and students must take the initiative to pursue them. New graduates hoping to work in technology-dependent industries need to acquire knowledge of their majors, but also exhibit strong teamwork, communication, and critical thinking skills along with more abstract characteristics like ethics and leadership. In the advice of the ILTM founder concerning college education, “Everyone should realize that it is only a starting point and continuing education is essential.” In any career, it is necessary to remain up-to-date on the most recent advances in related fields.

8.0 Acknowledgements

We would like to extend our sincere appreciation to all of the survey participants whose candid and insightful responses were essential to the completion of this study. Their willingness to be involved in the survey and their commitment to improving and facilitating interdisciplinary technology and management education is essential to the success of programs such as ILTM. We would also like to extend our gratitude to the members of the Bucknell faculty and staff who supported the survey process in various ways.

Bibliography


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project. She has declared a major in Civil and Environmental Engineering and is a member of the Society of Women Engineers and a class representative for Bucknell’s student ASCE chapter.

KEITH W. BUFFINTON is Associate Dean and Professor of Mechanical Engineering at Bucknell University. He earned his B.S.M.E., summa cum laude, from Tufts University and his M.S. and Ph.D. (with Prof. Thomas Kane) from Stanford University. His scholarly interests are in the modeling, dynamics, and control of complex systems, as well as sports engineering and engineering management education.
Appendix A

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Position</th>
<th>Company Description</th>
<th>Experience Level</th>
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<td>1</td>
<td>Human Resources Business Partner/Associate Manager</td>
<td>major pharmaceutical firm</td>
<td>mid-career</td>
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<td>2</td>
<td>Financial Accounting Manager</td>
<td>major manufacturer and service provider for health care products</td>
<td>10-20 years</td>
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<td>3</td>
<td>Manager of Campus Relations</td>
<td>world-wide technology, manufacturing, and services conglomerate</td>
<td>mid-career</td>
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<td>4</td>
<td>Sr VP of Engineering and Research; ILTM Founder</td>
<td>United Parcel Service</td>
<td>40+ years, now retired</td>
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<td>leading global financial services firm</td>
<td>mid-career</td>
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<td>University Relations Manager</td>
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<td>mid-career</td>
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<td>7</td>
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<td>internet-based financial organization</td>
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<td>1</td>
<td>Entry level engineering, 6-month rotational program</td>
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<td>Sales Marketing Manager</td>
<td>world-wide technology, manufacturing, and services conglomerate</td>
<td>5-10 years out of college</td>
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<td>4</td>
<td>Associate in Investment Banking/ Business Analyst</td>
<td>leading global financial services firm</td>
<td>recent graduate</td>
</tr>
<tr>
<td>5</td>
<td>Entry level</td>
<td>internet-based financial organization</td>
<td>recent graduate</td>
</tr>
<tr>
<td>6</td>
<td>Primary Middle Office Representative for Investment Advisor Trade Activity</td>
<td>leading global financial services firm</td>
<td>recent graduate</td>
</tr>
<tr>
<td>7</td>
<td>Entry level, Program management of integrating and testing projects</td>
<td>leading systems integrator and information technology company</td>
<td>recent graduate</td>
</tr>
<tr>
<td>8</td>
<td>Entry level, 2 year rotational program in Internal Consulting Services</td>
<td>leading global financial services firm</td>
<td>recent graduate</td>
</tr>
<tr>
<td>9</td>
<td>Program Engineer, ATV design</td>
<td>design and manufacture of recreational transportation and accessories</td>
<td>recent graduate</td>
</tr>
<tr>
<td>10</td>
<td>Fiduciary Account Officer</td>
<td>leading global financial services firm</td>
<td>recent graduate</td>
</tr>
<tr>
<td>11</td>
<td>Sr Level Design Engineer, advanced individual contributor</td>
<td>leading, worldwide medical products and services company</td>
<td>5-10 years out of college</td>
</tr>
</tbody>
</table>