Curriculum Innovation Driven by Industry Inputs:  
Engineering Technology Pathways

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Abstract

Consumers usually take for granted that the food they buy at any grocery store is of high quality and safe to eat, which is also one of the main concerns of any food producer. However, the food and foodstuff manufacturing areas are becoming more complex as a result of emerging business conditions such as global markets, government regulations and consumer practices. The needs of labor of many food companies have changed. Employers require advanced technical skilled employees with a comprehensive knowledge of food and foodstuff supply chain that are able to perform processes using operations management and biotechnology. These conditions have led to the initiative of creating a food and foodstuff concentration for the Engineering Technology Programs (ET) at the Associate’s and Bachelor’s levels. This initiative is supported by the National Science Foundation’s Advanced Technology Education (NSF-ATE) directive and its goal is to facilitate the student’s matriculation from the Associate to Bachelor level. This will allow meeting the critical need for specialized education in food and foodstuff industry. The content of this course concentration is the result of academic and industry interaction, tightly organized around engagement principles. This program may serve as a model for other institutional partnerships in the evolving STEM landscape.

Introduction

The current environment in which food and foodstuff supply chain operate in the United States is characterized by the fragmentation in operation management, lack of common standards, many regulations, and diverse management practices[^1]. This may be demonstrated by numerous failures in food safety and security. The United States has experienced numerous nationwide food safety recalls, reflecting the weaknesses in the current system. In 2010 alone,
there were 23 nationwide recalls \[2\]. One example was the DeCoster Egg Farms case, which was linked to the United States’ deadliest outbreak of salmonella infected eggs. As it was recalled, the root of the problem was that the company has grown quite large but the company was still operating like it was still small \[3\]. The DeCoster cases, as well as the recent nationwide spinach and peanut butter recalls \[4, 5\] highlight the critical need for improvement through operational management and excellence as a vehicle for organizing the entire supply chain. Implementing a more effective system requires more than technology deployment. The concept of integrating technology principles and processes is a systems framework. Personnel that operate as technologists require an educational pathway that encompasses Associates and Bachelor’s degree levels, comprehensive knowledge of the food and foodstuff supply chain and skills to incorporate application, higher order thinking, and advanced technical knowledge \[6\].

The U.S. Department of Labor’s Career Guide to Industries and Food Manufacturing \[7\] stated that due to technological investment in the food industry, employment growth in this area is expected to relate to personnel with technical expertise. However, the technology of the food and foodstuff supply chain has not been organized around the particular technologies deployed in it. The emergence of information technology and biotechnology over the last 30 years has highlighted the issues among parties involved in the entire process, from producers to retailers. Finally, security issues involving homeland and other securities have resulted in legislative mandates for better material management of commodities and products. These issues have resulted in numerous opportunities for improvement, but standards and policies are a looming factor in how the supply chain will organize itself around a more cogent, communicative, and managed industry sector. The needs for highly trained technicians and technologists is compounded by the fact that Indiana ranks only 35th in the U.S. in adult population with associate’s degrees and 47th in adult population with bachelor’s degrees \[8\]. Furthermore, the aging demographics of Indiana requires a workforce pursuing higher education to adapt to the rapidly changing marketplace in order to keep Indiana’s position as a leader in food production and processing \[8\].

The supply chain of food and foodstuff together is defined as the system of organizations, people, activities, information and resources utilizing a substance with food value before or after processing it \[10\]. This is recognition that food value is defined in numerous ways including direct
human consumption, animal consumption, alternative fuels and others. These aspects should be recognized when the entire supply chain concept is evaluated for improvement. Geography typically dictates how much of the supply chain is present. Indiana serves the need for improvement in the entire food and foodstuff supply chain. As with other Midwestern states, Indiana has the complete supply chain present: the state is not only a top producer and exporter in many food based commodities, but the increasing trend of internal or intrastate commerce has resulted in a growing agriculture biotechnology sector that utilizes Indiana’s significant manufacturing base. Thus, meeting the food production and distribution demands of manufacturers in Indiana requires human capital to operate the sector, involving advanced technical education.

In 2012, Purdue University and Ivy Tech Community College hosted three roundtables designed to bring Indiana’s highly specialized education in the food and foodstuff industries together. Since the academic system does not reach all audiences, the model to do it was engagement. This model is important to reach those individuals not involved in the original research sphere\(^{[1]}\). The goal was to determine the regional industry employment needs. The process was outcome based: participants were presented with the information above and a concurrent initiative to create a broad-based engineering technology Associate’s and Bachelor’s degrees articulated between both institutions. Industry, government, and academic personnel were asked what personnel skills and knowledge were required by the supply chain. The free flowing roundtable discussions resulted in a summary of three areas: Professional Skills, Technical Skills, and Advanced Technical Skills\(^{[6]}\). These areas are shown in table 1.

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<tr>
<th>Professional Skills</th>
<th>Technical Skills</th>
<th>Advanced Technical Skills</th>
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<tbody>
<tr>
<td>• Passion for career</td>
<td>• Problem solving</td>
<td>• Ability to work with advanced technology</td>
</tr>
<tr>
<td>• Common sense</td>
<td>• Managerial skills</td>
<td>• Knowledge of biologics</td>
</tr>
<tr>
<td>• Positive attitude</td>
<td>• Skills of working with automation</td>
<td>• Lean manufacturing</td>
</tr>
<tr>
<td>• Business writing skills</td>
<td>• Fundamental computer skills (excel spreadsheet)</td>
<td>• Bioprocessing</td>
</tr>
<tr>
<td>• Communications skills</td>
<td>• Knowledge of industry standards</td>
<td>• Microbiology</td>
</tr>
<tr>
<td>• Foreign language (esp. Spanish) is a must in production floor</td>
<td>• Knowledge of basic calculus and statistics</td>
<td>• CFR 21 standards</td>
</tr>
<tr>
<td>• Respect for bi-lingual or multi-lingual colleagues</td>
<td>• Ability to handle</td>
<td>• Regulations/operating systems and standards</td>
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<td>• People, leadership and</td>
<td></td>
<td>• GFSI</td>
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<td></td>
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<td>• ISO standards</td>
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### Professional Skills
- Supervision skills
- Advancement mentality
- Maturity
- Willingness to relocate, commute to rural area
- Willingness to get dirty, accept non-office jobs

### Technical Skills
- Biologically active items
- Workplace safety knowledge
- Bulk processing knowledge
- Market differentiation
- Project management

### Advanced Technical Skills
- Knowledge of OSHA, EPA, IDEM
- Project analysis skills
- Risk mitigation skills
- HACCP
- Hygienic design knowledge

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Table 1: Roundtable results of an ET concentration in the food and foodstuff concentration

### Methods

The foundation of the knowledge and skills noted in table 1 guides this collaborative project: Engineering Technology Pathways: the Food and Foodstuff Supply Chain [6]. The project ameliorates the workforce needs throughout the development of the concentration to encourage students to continue pursuing studies at the Bachelor level. This degree is established by meaningful milestones along the pathway of higher education in Engineering Technology. The opportunity for building an academic and industry pathway is great. In 2010, only 9% of the Community College students in the School of Applied Science and Engineering Technology finished with a four year Bachelor’s degree. Qualitative student feedback strongly supports a pathway concept with strong student and industry support.

Based upon the results in table 1, there were multiple methods of concentrating in the food and foodstuff area. The curriculum development model used in the project utilizes a standard outcomes based technique. The ASET and BSET plans of study were compared to the industry desired student outcomes. Professional skills and many of the technical skills were already encompassed in both plans of study. The advanced technical skills did not exist in the curriculum and are in development. One 3 credit hour course is an introduction to the food and foodstuff supply chain with the purpose of presenting the skills a systems integrator or technologist would need to understand for entry into the field. The second course in development is based upon standards and policies that encompass quality management related to the industries in this field. Courses are being developed utilizing the student-centered Wiggins and McTighe reverse design concept [9]. The focus is on student-generated evidence of understanding and working ‘backward’ through the curriculum. The Understanding by Design model guides the development of valid and reliable assessment instruments in the curriculum.
development efforts. The framework proposes a backward overview of curriculum development, starting with a clear definition of what the students should accomplish, and then designing a path for them to get there.

Following this idea and taking into account the needs collected in the round table discussions, the next step was to identify the desired results. This stage in the design process allows the identification of goals for each module by answering the following questions: What overarching understandings are desired? What are the overarching “essential” questions? What will students understand as a result of this unit? What essential and unit questions will focus this unit? As a result, the course content was grouped into 5 learning modules. These modules will address topics such as the economic and social implications of globalization in the food industry, the concept of quality and its principles, quality culture and ISO 22000, among others.

After completing the first stage, the next step was to determine what constitutes the acceptable evidence of student understanding. Overall, many tools will be used to assess process improvement of students in the class. For instance, traditional tests and homework, quizzes as well as blackboard discussions and case studies will be used. An innovative activity that would be implemented is the development of mock audits or mock recalls with local industries. These kinds of activities will provide students valuable hands-on experience in the field.

Finally, the third stage is still being developed, and it corresponds to planning the lesson plans and learning experiences. The goal is to connect all the understanding achieved with the two previous steps and create the most appropriate instructional activities.

The advances achieved in the project were shown to industry partners and current ET Ivy Tech students during the Engineering Technology Pathways Spring Summit 2012. Additionally, a discussion panel took place with the ET Advisory Board Members, seeking to collect industry insights about the project. At significant stages in the curriculum development, curriculum documents are sent to an industry advisory board enrolled from the roundtable events.

**Expected Results**

The Indiana Pathways for Engineering Technology project is intended to reach out to almost 30% of the population in some of the most economically challenged areas of the state where engineering technician education is provided. Students start at one of nine Ivy Tech
campuses, and then complete the single baccalaureate degree in Engineering Technology at one of Purdue University’s Statewide locations. This pathway will allow both traditional and non-traditional students across the state, including veterans, to remain in their community to seek higher education. The State will also benefit by gaining a more competent workforce with the ability to advance Indiana industries [6].

The intellectual merit of this project will be the development of articulation, course delivery, student support, and professional development solutions to provide maximum flexibility for students. The use of an external advisory board and evaluator will allow both planned formative and summative evaluation actions to be derived from the stated project objectives, planned activities, and outcomes [6].

The broader impact of this project will allow Ivy Tech students in any of the stated geographic regions within Indiana to continue to pursue a BSET degree at one of the four Statewide Technology locations. This solution is intended to be scalable in other regions of Indiana and adapted to other institutions in other parts of the country.

Conclusions

Programs such as Engineering Technology Pathways represent a big opportunity for communities. They contribute to the progress of specific regions through the creation of strong Industry-Academia relationships, building networks and forging synergies that will impact the local economies long-term. This project is intended to serve as a model for future pathways in other areas.

In early stages of the process, the work has been done throughout strong collaboration of the different parts involved, but the project success will be determine by the marketing strategy used to attract students and encourage them to transfer into the university.
Reference


