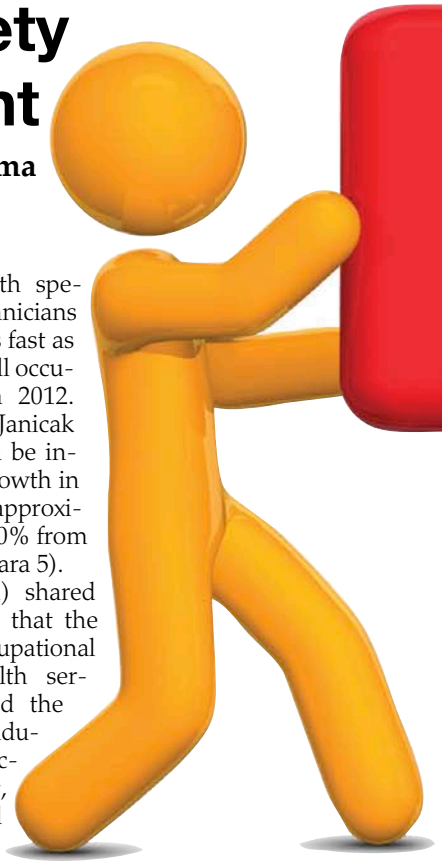
SH&E Curriculum

Involving Practicing Safety Professionals in Its Development

By Shoji Nakayama



IN BRIEF

- **How can an academic institution be sure the knowledge it provides to students is truly needed by industries that will be hiring its graduates? Academic programs should view students as "products" of institutions and industry as a "customer" who invests in that product.**
- **To educate students to meet industry needs, institutions must incorporate safety professionals' input to enhance SH&E-related curricula, and must develop a systematic, documented way to incorporate this feedback to improve their programs.**
- **This article discusses a process that a regional campus of a large Midwestern academic institution has undertaken to develop its SH&E curriculum.**

Board of Certified Safety Professionals (BCSP, 2009) defines *safety professional* as:

> [O]ne who applies the expertise gained from a study of safety science, principles, practices, and other subjects and from professional safety experience to create or develop procedures, processes, standards, specifications, plans and systems to achieve optimal control or reduction of the hazards and exposures which may harm people, property and/or the environment. (p. 3)

The SH&E profession has evolved in breadth and complexity over time because of implementation of technology, manufacturing processes and chemicals; development and proliferation of standards and federal legislation; litigation; and economic changes. As academic institutions prepare students, the SH&E curriculum must be aligned with business and industry needs. Therefore, educators need to fully assess and understand the market for safety program graduates.

Recent Trends

Recent reports suggest that the safety discipline will soon face a shortage of qualified individuals working in the field (Janicak, 2010; NIOSH, 2011). According to Janicak (2010), retirement is one major contributing factor to this trend. Bureau of Labor Statistics (BLS, 2005) expects careers as occupational safety and health specialists and technicians to grow about as fast as the average for all occupations through 2012. According to Janicak (2010), "this can be interpreted as a growth in employment of approximately 10% to 20% from 2002 to 2012" (para 5).

NIOSH (2011) shared similar concerns that the demand for occupational safety and health services will exceed the number of individuals with the necessary training, education and experience. The NIOSH study revealed that employers are planning to hire more than 25,000 occupational safety and health professionals over the next 5 years.

Who will replace the experienced safety professionals retiring in the next several years? Employees already on staff could replace senior safety personnel, or companies could hire new staff from other organizations. In addition, more companies are hiring safety professionals who not only have experience and certifications, but also have a 4-year degree in an SH&E-related discipline. Thus, universities and colleges have become feeder programs to organizations hiring safety professionals. Although the number of positions that will be filled by new graduates or members of the existing professional ranks is unknown, the literature indicates a need to produce additional graduates.

What do academic programs need to offer to those students? Are we providing adequate information and education? Each institution must answer these questions in order to provide solid programs that produce qualified students who

Shoji Nakayama, Ph.D., is an assistant professor at Purdue University Calumet (PUC) in the Organizational Leadership and Supervision program within the Department of Construction Science and Organizational Leadership. He holds a B.S. in Safety Management and an M.S. in Industrial Management from Central Missouri State University, and a Ph.D. in Technology Management from Indiana State University. Before joining PUC, Nakayama worked for a telecommunication company as an environmental safety and health systems analyst. He is a member of ASSE's Greater Calumet Chapter.

have the skills and knowledge needed in business and industry today.

One way to achieve this is to involve safety professionals in curriculum development and to gain the input of those who will be hiring SH&E graduates. These professionals lend credibility to the program and have a better understanding of what graduates need to know in order to add value to their organizations.

Advisory Group/Committee

An advisory group is an informal meeting of carefully selected individuals who gather regularly (e.g., one to four times per year) to discuss business and its needs (Margolis & Becker, 2008). According to Silver (1992), involving local SH&E professionals helps connect academic institutions to the external community. These professionals can share their expertise and experience after gaining practical experience in the field. This is why engineering-related programs, regardless of their field of study, often use advisory boards to provide support and advice to educational programs. Most universities that offer accredited degree programs have established some form of advisory group comprised of either practicing or retired professionals who lend support in various ways (Genheimer & Shehab, 2009).

Benefits for Institutions & Advisory Group Members

Involving SH&E professionals in curriculum development benefits them as well as academic institutions. As this comment from one participant shows, committee members are interested in seeing their field grow:

> The reason to get involved . . . is to give back to the profession and to provide advice to the university to ensure that the quality of the education is such that the skills of tomorrow's safety professionals match the EHS challenges found in industry.

Such involvement exposes SH&E professionals to the academic environment, which gives them the opportunity to help the institutions identify and bridge gaps. For example, one committee member noted that he was asked to perform job functions to which he had no exposure during his education. He decided that if ever given a chance to correct that deficiency, he would participate in the endeavor. Thus, advisory committee members help steer the educational program in a direction that will meet industry's dynamic needs.

In addition, participation helps members connect with other disciplines. As one participant in the advisory group in this case said:

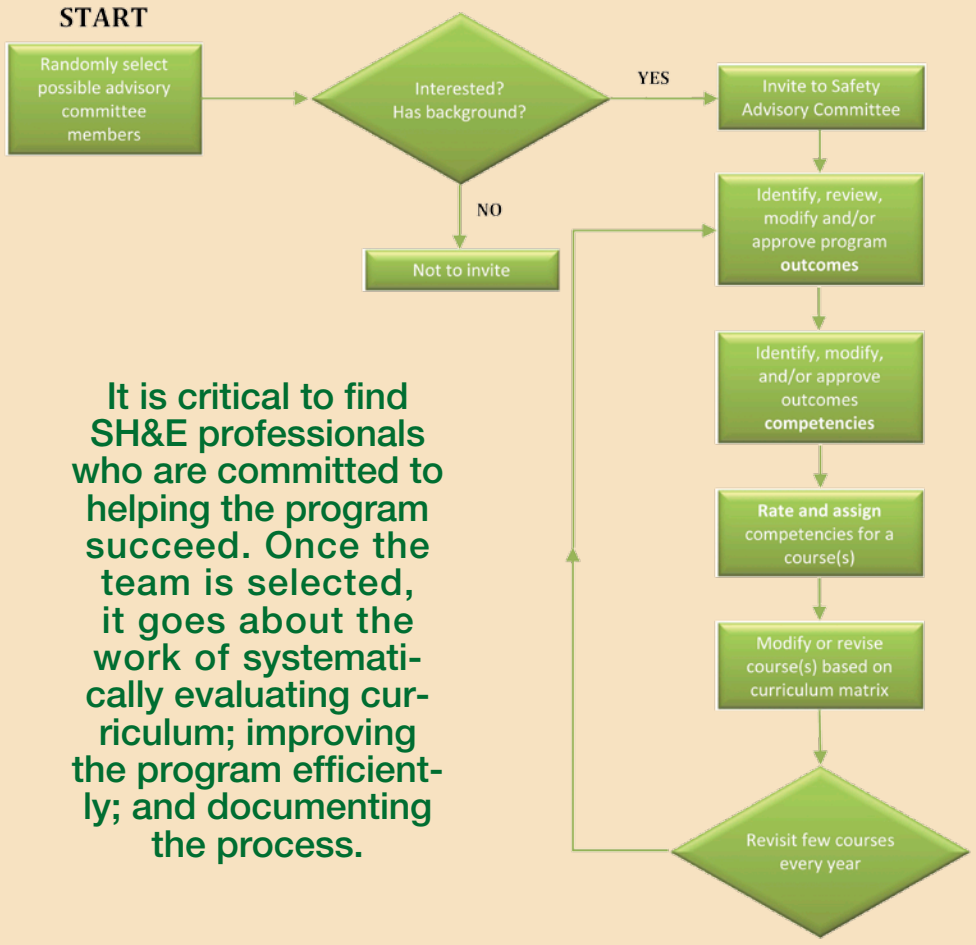
> Advisory groups are one way to round out [my] professional and personal career. To truly reach self-fulfillment, one must broaden one's horizon to include some ways to give back to the community. Advisory groups are one way to do that outside of charitable organizations.

It is also in employers' best interest if academic institutions graduate quality candidates who are prepared for employment. Many employers prefer graduates who have proven leadership and communication skills as well as the technical aptitude to perform work tasks in a professional environment with minimal direction.

As noted, one goal for educational institutions is to prepare students to meet the demands set by society or industry. Thus, educators must be aware of changes taking place in their related industry and adjust their curricula, course objectives and materials to reflect these changes. As Marshall (1999)

Figure 1

EHS Advisory Committee Flowchart



It is critical to find SH&E professionals who are committed to helping the program succeed. Once the team is selected, it goes about the work of systematically evaluating curriculum; improving the program efficiently; and documenting the process.

states, technology instructors must maintain "cutting edge" knowledge and skills in order to keep content current and effectively prepare students for the workplace. As industry must take a leading role in the structure and administration of future training for that industry, it must create a link between academic programs and industrial demands. If institutions allow their perspective to be confined to the theoretical, they will be missing important opportunities to expand their services or take advantage of industrial trends (Marshall, 1999).

Literature stresses the importance of and roles played by an advisory committee. However, it contains little information as to how to proceed and document input received from advisory committee members. This case study details how one safety program at a regional university located in a highly urban and industrial region in the midwestern U.S. serving roughly 9,500 students annually, has designed a curriculum to keep the institution competitive through working with the Environmental Health and Safety Advisory Committee (EHSAC).

One primary goal of this process is to achieve a 100% employment rate after student graduation. By collaborating with the EHSAC, the program has aligned its educational outcomes to industry requirements. Since the committee has no direct relationship to institutional business and nothing to gain from its operation, members' input is thoughtful, unbiased and "outside the box" of traditional institutional approaches (Margolis & Becker, 2008).

Through the EHSAC, the university department can ensure the academic quality of courses by monitoring and subjecting them to reviews and improvement through a constant cycle. In this case, the EHSAC uses well-established academic criteria set by ABET and BCSP, along with input from experts in the field. Committee members help evaluate the safety degree program to maintain program consistency with safety-related skills necessary in the industry.

Participant Selection

It is critical to find SH&E professionals who are committed to helping the program succeed. A criterion-based survey tool was used to gather information from EHSAC members and SH&E professionals from the region including networking groups such as the local ASSE chapter.

These professionals were chosen based on their background as well as which industry they represent. The most effective advisory groups often have representation from a variety of disciplines (Margolis & Becker, 2008). EHSAC members represent industries such as chemical, construction, legal, healthcare, insurance, manufacturing, refinery, regulatory agency, telecommunication, utility, and safety and health consulting. This broad representation is important because each individual entering the workforce must be exposed to various topics and issues that they may encounter. Input received from members who represent different industries allows students to learn more about hazards in diverse areas of industry.

It is often easier to find advisory board members than to keep them active in the process. Too often, members and potential members find themselves overcommitted with their jobs and unable to participate fully or attend the scheduled meetings. Indeed, most members intend to help, yet job demands become an obstacle to providing guidance to the program. When selecting candidates, be sure to inform them how often they will meet each semester to evaluate programs.

To be respectful of committee members' time, it is advisable to send meeting schedules and discussion items electronically in advance. Although in-person meetings are best, this EHSAC meets via conference call. This facilitates participation and increases meeting effectiveness. In this case, the initial meeting was held in person while the remaining meetings have been a combination of face-to-face and teleconference meetings.

Development of a Curriculum Matrix

The model that yielded the best results for updating the curriculum is based on the use of a systematic tool to analyze the program, called a curriculum matrix. It allows an institution to systematically evaluate curriculum; improve the program efficiently; and document the process. Figure 1 shows the typical steps involved in reviewing content by major.

A curriculum matrix is used to review program outcomes, competencies and course alignment. This procedure can be applied to other safety and health programs, as well as other disciplines within higher education where program improvements are needed. This procedure also meets the ABET criteria for accrediting applied science programs, specifying that programs must have a documented process to routinely review educational objectives and program outcomes. A discussion of each step follows; these steps can be easily modified depending on each institutional need. This process is normally led by the program coordinator.

Identification of Safety Major Outcomes

After forming the EHSAC, a team first identified outcomes that graduates should possess in different areas. During the initial brainstorming session, each member was tasked with identifying areas of concentration in which safety professionals must be knowledgable; these included SH&E management, industrial hygiene, fire protection, loss control and construction safety. Although this step was conducted during the initial meeting, it could be done in advance via e-mail. Instruct members not to think in too much detail, as they are only providing a list of those areas students will be learning.

Once key outcomes are identified, the committee held discussions to form consensus. This was done in face-to-face meetings and through teleconfer-

Table 1
Example of Entry by EHSAC Member

Outcomes	Competencies	OLS 33100 Intro EHS	OLS 33200 Intro IH	OLS 33300 EHS Laws	OLS 33400 Haz Mat	OLS### XXXXX
SH&E Management	Build/implement EHS management systems	3	2	2	3	2
	Certification and standards	1	3	3	2	0
	Contractor safety	2	1	2	1	2
	International safety program management	1	1	2	1	2
	Motivating and monitoring safety programs	3	2	2	2	1
	Quality principles and safety	2	1	2	1	0
	Risk assessment and management	3	3	1	1	3
	System safety	1	3	2	1	1
	Techniques of safety management	2	1	1	1	2
Industrial Hygiene (IH)	Ergonomics	1	3	0	0	0
	Ergonomics evaluation tools and guidelines (e.g., NIOSH, OSHA, etc.)	2	3	1	0	1
	Hazard control	1	3	1	1	2
	Hazard assessment protocol	3	3	2	1	3
	Industrial hygiene principles	2	3	1	0	0
	Industrial hygiene laboratory	1	3	0	0	0
	Industrial hygiene and ergonomics report writing	3	3	1	0	0
	Recognition and evaluation tools	2	3	2	0	2
	Toxicology	1	3	1	0	0

Table 2
Cumulative Ratings From Group Members

Outcomes	Competencies	OLS 33100 Intro EHS	OLS 33200 Intro IH	OLS 33300 EHS Laws	OLS 33400 Haz Mat	OLS### XXXXX
SH&E Management	Build/implement EHS management systems	12	5	5	3	7
	Certification and standards	7	8	7	6	6
	Contractor safety	6	5	6	10	6
	International safety program management	4	1	2	1	5
	Motivating and monitoring safety programs	11	6	5	9	6
	Quality principles and safety	4	2	6	1	4
	Risk assessment and management	10	12	3	10	12
	System safety	3	1	5	2	7
	Techniques of safety management	14	3	4	3	9
Industrial Hygiene (IH)	Ergonomics	4	12	0	0	6
	Ergonomics evaluation tools and guidelines (e.g., NIOSH, OSHA, etc.)	3	12	1	0	5
	Hazard control	5	9	4	1	8
	Hazard assessment protocol	12	12	3	1	5
	Industrial hygiene principles	6	15	2	0	5
	Industrial hygiene laboratory	1	15	0	0	3
	Industrial hygiene and ergonomics report writing	3	12	2	0	3
	Recognition and evaluation tools	4	14	2	0	4
	Toxicology	4	12	1	0	2

Customers for academic institutions are the entities who hire graduates. To meet their demands, academic programs must incorporate what customers are seeking.

ences so that members could share opinions and determine whether modifications were required.

For example, in this case, industrial hygiene and ergonomics were separate outcomes during the initial discussion. However, the team decided to combine those two outcomes and place the combined result under the industrial hygiene outcome. As each member has an SH&E background, this process went smoothly and members often reached agreement quickly.

Identification of Competencies for the Safety Major

Once program outcomes are established, EHSAC members identify competencies or skill sets required to meet each identified outcome. Competencies were outlined in greater detail than outcomes, which are considered the program's general, overall goals. Competencies are the subset of program outcomes, and indicate what knowledge and skills a graduate will need to perform better in the field.

For example, what skill sets, knowledge or competencies are necessary for graduates to understand an industrial hygiene outcome? Does a student need to know about hazard assessment, toxicology, ergonomics or other topics? Each member draws on his/her own experience to list appropriate competencies. These lists are then returned to the committee leader by an assigned date.

EHSAC members had to work together to achieve consensus on those competencies that would best benefit students as well as prospective employers. Reaching consensus about competencies was more complicated than developing major outcomes. This was because for each outcome, the committee had to consolidate members' suggestions, which were based on personal experiences. One issue that may arise during this step is that some competencies overlap. Such overlap shows that committee members are emphasizing the issues which need to be addressed. So, if overlap occurs, the group may need to balance competency placement by moving or combining identified competencies. Once consensus was reached as to which competencies are essential to mastering identified outcomes, each member rated each competency applicable for existing courses.

Assessment of Criteria

Each EHSAC member was asked to rate or rank the priority of each competency for existing SH&E courses. Each member was asked to indicate which identified competency(ies) should be addressed in which course, based on course descriptions that were given to EHSAC members. The following rating scale was established:

0: Competency not necessary in the course
1: Low priority value
2: Medium priority value
3: High priority value

Survey Results

Table 1 (p. 71) shows a portion of one member's result during rating of competencies for each class. Since there are no right or wrong responses, each member must use his/her best judgment as to which competency is essential for existing courses. In other words, a member must rate an entire curriculum matrix based on his/her experience and judgment. As this example shows, this member applied a rating of 3, high priority, to the first competency (build/implement EHS management systems) listed under SH&E management for the OLS 33100 course.

Table 3
Competencies Applicable to Each Course

Outcomes	Competencies	OLS 33100 Intro EHS	OLS 33200 Intro IH	OLS 33300 EHS Laws	OLS 33400 Haz Mat	OLS### XXXXX
SH&E Management	Build/implement EHS management systems	12	5	5	3	7
	Certification and standards	7	8	7	6	6
	Contractor safety	6	5	6	10	6
	International safety program management	4	1	2	1	5
	Motivating and monitoring safety programs	11	6	5	9	6
	Quality principles and safety	4	2	6	1	4
	Risk assessment and management	10	12	3	10	12
	System safety	3	1	5	2	7
	Techniques of safety management	14	3	4	3	9
Industrial Hygiene (IH)	Ergonomics	4	12	0	0	6
	Ergonomics evaluation tools and guidelines (e.g., NIOSH, OSHA, etc.)	3	12	1	0	5
	Hazard control	5	9	4	1	8
	Hazard assessment protocol	12	12	3	1	5
	Industrial hygiene principles	6	15	2	0	5
	Industrial hygiene laboratory	1	15	0	0	3
	Industrial hygiene and ergonomics report writing	3	12	2	0	3
	Recognition and evaluation tools	4	14	2	0	4
	Toxicology	4	12	1	0	2

Analysis of Response

After members rate the competency that corresponds to each course, the EHSAC facilitator compiles all ratings into one document, and calculates a cumulative rating for each competency that falls under each course (Table 2, p. 71)

Suppose, for example, that there are five EHSAC members: Member-A, Member-B, Member-C, Member-D and Member-E. Each member rates "build/implement EHS management systems" as a competency for OLS 33100. Member-A assigns a rating of 1, low priority. Members C and D feel the competency is high priority, so they each rate it a 3. Member-E thinks this competency is a medium priority and rates it a 2. To obtain the final

rating score for the this competency for OLS 33100, the ratings are tallied and, in this example, the rating would equal 12.

Based on these results, the facilitator highlights which competencies should be included in each course. Returning to the previous example, the facilitator divides the total member rating (in this case, 12) by the total maximum possible rating (15, which is the maximum rating of each competency multiplied by the number of members, in this case, 5); this equation produces a percentage (12/15 = 0.80 or 80%) and gives the facilitator a method to select the competencies that score above a certain percentage.

This EHSAC decided to include only those competencies that rate 60% or higher. Table 3 shows the competencies in the example that rated higher than 60% (indicated in bold red numbers) and how they would be used to select course objectives/requirements. Upon completion of this step, the curriculum matrix for the major is complete and can be used for course development.

Modify a Course Based on the Curriculum Matrix

Each instructor is now ready to use this matrix to develop or revise course objectives using the highest-rated competencies; the competencies will become the minimum requirements for a course. Each instructor can add course material beyond these competencies to the degree s/he determines is feasible. This allows students to be exposed to different instructors with a wide range of experiences.

Revisit Three Courses Each Year & Revise as Necessary

The last step is to set the curriculum review process. Keeping up with changes and industry demands requires a continual review process. This allows the program to stay consistent with industry trends and keep the SH&E major marketable. Optimally, a program should be reviewed twice annually. It is recommended that advisory board members review only a few courses per meeting. Too much review work in a single meeting can dilute the amount of review time the board can spend with each course or component. In this case, EHSAC meets at least once every semester and reviews three courses at most to validate the currency of its curriculum.

Consensus Decision Making

Typically, EHSAC members do not want to sacrifice their time suggesting information or ideas that will not be implemented. The program in this case study tries to ensure that members' input directly affects the development of the major's curriculum. Moreover, each group member is allowed to contribute to the discussion until a general agreement has been reached. This can lengthen the time needed for discussions and to achieve a final decision. However, in this case, such an approach has led to well-thought-out decisions that keep the advisory committee members coming back.

Conclusion

Meeting customer demands is an important aspect of any business. This concept also can be applied to the relationship between academia and industry. Customers for academic institutions are the entities who hire graduates. To meet their demands, academic programs must incorporate what customers are seeking.

For this case study, a systematic process was used to show how educational institutions can identify and understand what industries are looking for in university graduates. To this end, the following procedures have been enacted to ensure that program quality is maintained:

1) Contact and recruit appropriate EHSAC members.

2) Assign members to identify fundamental program outcomes.

3) Achieve consensus on program outcomes.

4) Utilize members to identify competencies required for each outcome.

5) Come to consensus of outcome competencies.

6) Rate and assign each competency for courses in the program.

7) Modify a course based on the curriculum matrix.

8) Revisit select courses regularly to revise as necessary.

This process provides for continual improvement and serves to keep curriculum up-to-date in accordance with the needs of business and industry. Thus, it provides benefits for all stakeholders—academic institutions, potential employers and students. **PS**

References

Board of Certified Safety Professionals (BCSP). (2009). *Application guide: Certified safety professional.* Retrieved Dec. 12, 2011, from **www.bcsp.org/pdf/aspcsp/appguideoct2009.for_web.pdf**.

Bureau of Labor Statistics (BLS). (2005). *Occupational outlook handbook: 2004-05.* Retrieved Nov. 14, 2011, from **www.bls.gov/oco/ocos017.htm**.

Genheimer, S.R. & Shehab, D.L. (2009). A survey of industry advisory board operation and effectiveness in engineering education. *Journal of Engineering Education, 98*(2), 169-180.

Janicak, C.A. (2010). Is history repeating itself? Retrieved April 7, 2010, from **www.asse.org/practicespecialties/articles/janicak.php**.

Margolis, S.W. & Becker, S. (2008). Advisory groups: Your unofficial board of directors resource. *Printing News.* Retrieved June 20, 2010, from **www.margolisbecker.com/Downloads/Publications/Advisory%20Groups.pdf**.

Marshall, J.A. (1999). Maximizing your industrial advisory board. *Journal of Industrial Technology, 15*(2), 2-5.

NIOSH. (2011). National assessment of the occupational safety and health workforce. Retrieved Nov. 7, 2011, from **www.cdc.gov/niosh/oshworkforce**.

Silver, G. (1992). Advisory boards: Academic partnerships that work. (ERIC Document Reproduction Service No. ED343 626).