

Curriculum Innovation Driven by Industry Inputs: Case Studies

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Introduction

In the past few years, The Metropolitan State University of Denver (MSU Denver) has experienced some curricula changes either driven or impacted by industry inputs. These changes include creations of certificates and undergraduate majors. This paper presents the case studies in creation of three academic programs: Construction Project Management (CPM) major, Facility Management (FM) major, and Engineering Manufacturing certificate.

In 2016, a group of Colorado construction companies led by Rocky Mountain chapter of the Associated Builders and Contractors and the Associated General Contractors of Colorado approached MSU Denver exploring the possibility of creating a new academic major in construction project management. Although construction industry is booming in Colorado, we want to make sure that four-year degree graduates are needed and, if so, what subjects are preferred in the curriculum. We created a major in construction project management (CPM) with two concentrations based upon our survey results. The program was approved by Colorado Department of Higher Education (CDHE) in summer 2016 and officially launched in fall 2016. Currently we have over one hundred declared majors.

In fall 2017, representatives from Facility Management Accreditation Commission (FMAC) and International Facility Management Association (IFMA) Foundation contacted us to discuss the possibility of creation of a facility management program. IFMA Accreditation and Academic Affairs provided us with core competencies as guideline for the curriculum creation. The facility management program will be added to CPM as the third concentration.

Some of the immediate demand from the industry may not require a full four-year degree. A certificate program will be a great answer to such demand. Our certificate in engineering manufacturing was created to response the need of the manufacturing industry due to the labor shortage in Colorado. The certificate was initially proposed by Denver local companies, CareerWise Colorado, Mikron, Intertech Plastics, and Andrew. With the certificate, a student should be able to start his or her career in mechanical or industrial engineering technician positions with a chance to move into quality assurance expert jobs or become lean manufacturing specialists. Also, since all of required courses can be applied to the manufacturing concentration of mechanical engineering technology (MET), a student can come back to MSU Denver to pursue a BS degree in MET or in the Advanced Manufacturing Science (AMS) in the future.

From our experience, a four-year degree driven by the industry will be a multidisciplinary degree from traditional academic point of view. There is usually minimal requirement in creating new courses if academic departments work collaboratively..

Construction Project Management Degree

In spring 2016, MSU Denver, responding to and in collaboration with industry advisors, explored the potential of a new 4 year Bachelor of Art degree in Construction Project Management (CPM).

This degree would be designed primarily for existing employees in the building trades and would allow a specified amount of college credits for completing an accredited apprenticeship or other on-the-job-training (OJT) programs. The goal was to create pathways for existing trade employees to transition into estimating, preconstruction, supply chain, project management or other key leadership positions in construction organizations. This pathway would grant those employees the opportunity to apply previous training, apprenticeship and OJT in a meaningful amount of credit hours toward a Bachelor's degree. The difference between this degree and existing Construction Management degrees offered by other universities in Colorado will be its more practical, experience based focus as opposed to the more typical theoretical orientation. The degree will be further distinguished by its granting college credit for registered apprenticeship programs or other industry training.

In order to exam the feasibility and usefulness of such program, MSU Denver conducted a series of survey. Survey responses would only be used internally at MSU Denver to direct curriculum development and potentially market the new degree. In this paper we use secondary survey data.

The first survey aimed to understand the interests in such degree from employers' point of view.¹ Distributed with the help of the Presidents of the Rocky Mountain chapter of the Associated Builders and Contractors and the Associated General Contractors of Colorado, the result of the survey indicated strong support for the type of degree proposed, referring to Figure 1. Survey response: importance of a pathway to a 4 year BA degree in construction project management for your company and employees.

The numeric responses 1-4 indicate the following: 1= No interest, these skills are readily available in the marketplace. 2=I could see some benefit to this, degree not necessary, but training would be good. 3= If the employee pursued this, I would look favorably towards them. 4= critical for the future growth of my company, I'd even be willing to invest in this type of training for my employees. Employees coming out with this type of training would be highly valuable to me (my company).

Out of 44 total responses only 3 respondents had no interest, 8 saw some benefit, 22 viewed it favorably and 11 felt that it was critical for the future growth of their company and that employees with this type of training would be very valuable.

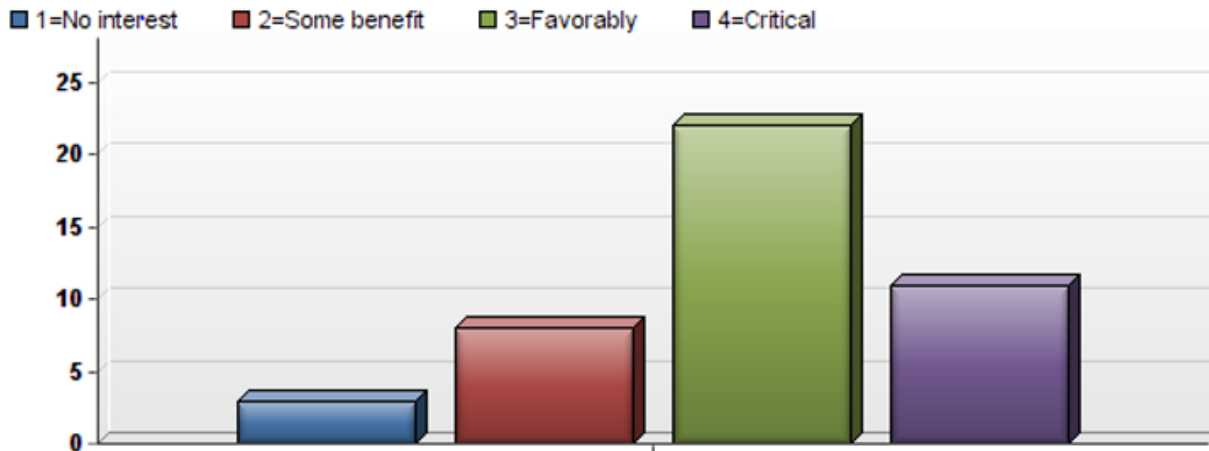


Figure 1. Survey response: Importance of a pathway to a 4 year BA degree in construction project management for your company and employees

While employers strongly supported the concept, verification of employees’ interest was also researched. The second survey was distributed to employees of major Denver metro area construction companies to ascertain the interest of employees in pursuing the CPM degree. As was the case with employers, employees also showed strong interests in the proposed program as indicated in Figure 2 below. This figure shows results to the question – Do you have an interest in moving into management positions in your company that may require a Bachelor’s degree? The data indicates that 71% of responding construction industry employees do have the interest in pursuing positions that would require a baccalaureate degree such as the CPM degree.

#	Answer	Bar	Response	%
1	Yes		93	71%
2	No		38	29%
	Total		131	

Figure 2. Survey response: Do you have an interest in moving into management positions in your company that may require a Bachelor’s degree?

Respondents were also queried as to how likely they would be to pursue the perspective CPM degree. A total of 73% of the employees indicated that they would be at least somewhat likely to pursue the degree while 49% were very or extremely likely to pursue the CPM degree, as shown in Figure 3.

The survey results indicated a good opportunity for development of such a degreed program. In order to produce a curriculum with required elements from the industry. A questionnaire was sent to employers who are interested such program to collect ideas and contents should be included in the curriculum. Based upon the responses, the last survey was created and sent to employers to identify the importance of each topic in the perspective curriculum. Table 1 shows the rank of topics that are considered as required for managerial (or higher) positions that require a 4-year degree. Only the topics supported by at least half of the responding companies was

included in the table. Table 2 shows the top 10 areas that are considered as critical for degreed position(s).

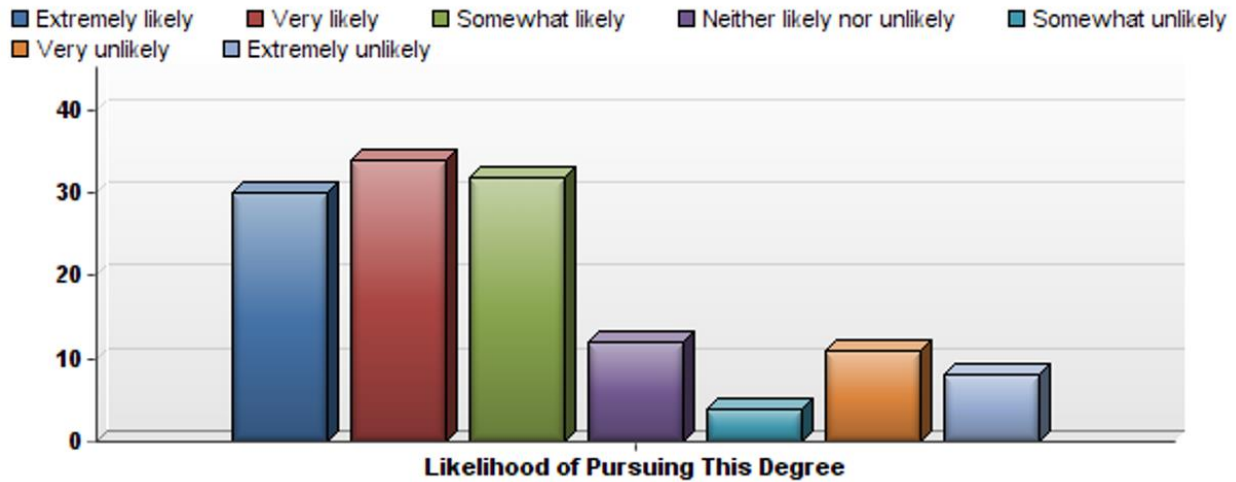


Figure 3. Survey response: How likely would you be to pursue the CPM Degree

In the tables, TR stands for total number of responses. Columns marked 3 in table 1 and 4 in table 2 reported numbers of company who check the fields, where 3 stands for Required for Managerial (or higher) Positions that Require a Degree and 4 for Critical for Degreed Position(s). Mean gives the mean value (between 1-4) reported by all participating companies.

Table 1. 3 = Required for Managerial (or higher) Positions that Require a Degree

Question	3	TR	Mean
Composing business communication (letters, RFI's/ASI's, scope letters, contracts, etc.)	31	49	3.1
Scheduling (MS Project or other)	30	49	2.98
Building and interpreting job cost reporting	29	48	3.06
Building teams	29	48	2.98
Site logistics	29	48	2.9
Understanding cost impacts of a change order	27	48	3.1
Building budgets	27	48	3.02
Estimating	26	46	3.04
Developing and utilizing schedules of values	26	48	2.98
Basic construction finance	26	47	2.87
Building an estimate	26	48	2.85
Building an invoice to American Institute of Architects (AIA) standards	26	48	2.6
MS Office (Including Outlook, Excel, Word, PowerPoint)	25	49	3.14
Team work	25	49	3.08

Pricing change orders	25	48	3
Resource forecasting (labor, rental equipment, materials, subcontractors)	25	49	2.98
Contract negotiations	25	48	2.9
Complying with Gross Maximum Pricing (GMP) contracts	25	48	2.71
Time management skills	24	49	3.14
Building forecasts	24	48	3
Presentation skills	24	48	2.92
Workplace preparation/soft skills:	24	45	2.91
Human resource management, employee training and development	24	47	2.57

Table 2. 4 = Critical for Degreed Position(s)

Question	4	TR	Mean
Problem solving	30	49	3.47
Communication skills	30	49	3.45
Understanding schedule impacts	23	48	3.31
Safety including how safety affects business, morale and profitability	22	47	3.28
Planning and scheduling	19	45	3.27
Basic computer skills (file locating, saving, retrieval, internet searching)	20	49	3.22
Develop construction schedules	18	46	3.22
Leadership	19	47	3.19
Basic blueprint take-off skills	18	48	3.15
Time management skills	17	49	3.14

Based upon the survey data, a new 4-year degree program, Construction Project Management Major with two concentrations, Computer Information Systems Concentration and Management Concentration, was created and added in the university catalog 2016-2017. The program was approved by Colorado Department of Higher Education (CDHE) in summer 2016 and officially launched in fall 2016. By census day of fall 2018, there are 142 declared majors and 85 have enrolled in courses offered for this program. For details of the program, please refer to MSU Denver undergraduate catalog at http://catalog.msudenver.edu/preview_program.php?catoid=23&pooid=5894&returnto=1306.²

One important feature of this program is that students with a completed U.S. Department of Labor (DOL) Office of Apprenticeship (OA) four-year Registered Construction Trades Apprenticeship and journeyman's credentials are awarded a block of 30 lower division semester credits that may be used in lieu of the required minor.

For students who are not currently involved in the construction industry, six credit hours of internship is required besides their minors. Many participating companies have expressed interest in hosting interns to support CPM program.

Facility Management Degree

When representatives from the Facility Management Accreditation Commission (FMAC) and International Facility Management Association (IFMA) Foundation approached MSU Denver to explore the possibility of creation of a Facility Management program in fall 2017, we faced a totally different scenario as described above.

The IFMA Foundation is aware of over 100 different FM degree programs worldwide. There are currently 30 different accredited degree programs with about a dozen more planning to go through accreditation. A program seeking IFMA accreditation must demonstrate that it is housed within an institution that is accredited or recognized by: An institutional accrediting body that is recognized by the U.S. Department of Higher Education, or the appropriate higher education agency or authority in the institution's country of origin.³

IFMA/FMAC presented its "Standard for Facility Management (FM) Accredited Degree Programs (ADP)" which apply only to facility management degree programs at the undergraduate (associate/diploma, baccalaureate) or graduate level (masters) universities and colleges offering such programs that shall adhere to these standards when seeking FMAC accreditation. Based upon the IFMA 2009 Global Job Analysis Study, the ADP core competencies and outcome based assessment expectations have been developed. The eleven core competencies are as follows:³

1. Leadership and Strategy;
2. Operations and Maintenance;
3. Project Management;
4. Communication;
5. Finance and Business;
6. Human Factors;
7. Quality;
8. Real Estate and Property Management;
9. Technology;
10. Emergency Preparedness & Business Continuity;
11. Environmental Stewardship & Sustainability

This standard describes both scholarly and real-world facility management applications and practices and provides a comprehensive model for an ideal facility management program. The FMAC establishes standards for accreditation so that a facilities management program's outcomes can be measured by how well core competencies are being demonstrated. Each program is encouraged to retain its uniqueness while providing the basic curricular structure needed to assure that graduates are prepared for real-world careers in facility management.³

After initial meeting with local IFMA representatives, the faculty from CPM program and department of engineering and engineering technology of college of professional studies and department of computer information systems and department of management of college of business worked together created initial curriculum layout. The initial curriculum was submitted

to IFMA executive director then distributed to IFMA university relations personnel. Two web meetings were hosted by IFMA executive director with participants from MSU Denver, IFAM personnel from Denver, CO, Huston, TX and New York. The facility management program curriculum was finalized based upon the detailed ADP standard outcome course map for curriculum construction provided by FMAC.

The proposed curriculum will be submitted to MSU Board of Trustee for approval in October 2018. We decided that the facility management program will be added to CPM as the third concentration. We also communicated with IFMA/FMAC that in order to have a faster turnaround, as we develop the curriculum in fall 2018 and know the sequence of classes that are needed, the students will be allowed to start taking those classes as early as spring 2019. The participating students just won't be able to declare the major and concentration until the curriculum is finalized through the curriculum approval process. They can work with advisors on which classes to take to stay on track.

Comparing to the current MSU Denver university catalog, only a few new courses are needed for the new degree program. Business and Sustainability and FM internship will be developed by MSU Denver faculty. The Denver chapter of IFMA agreed to develop two new FM specific courses for Professional Skills, Technical Skills, and Advanced Technical Skills.^{4,5} They are introduction to facility management and FM technology and software. Six credit hours internship is also a required element in this curriculum. IFMA will help to create internship opportunities for students, which will polish students' professional preparation.⁶

Engineering Manufacturing Certificate Program

Another example is the engineering manufacturing certificate program proposed by CareerWise Colorado and some Denver local companies. CareerWise Colorado was envisioned by its founder and CEO Noel Ginsburg and Colorado Governor John Hickenlooper following a 2015 trip to Switzerland to learn about its youth apprenticeship system. As a nonprofit intermediary, CareerWise's program crosses Colorado's geographies and industries, and provides students a practical learning experience to augment the classroom in fields such as healthcare, business operations, information technology, advanced manufacturing, and financial services.

Apparently, CareerWise and companies have studied MSU Denver curricula and came with proposed required and elective courses for this certificate program. After communication amongst faculty experts and representatives of CareerWise and companies, we obtain better understanding of the purpose of such certificate. We modified some of the proposed course selections and proposed the certificate which will meet the current needs of the industry with the consideration of the future career advancement of participating students and also made sure that there is no conflict with similar certificate programs offered by local community colleges. The engineering manufacturing certificate program was created with 19 credits hours required courses and 6 elective credits from 6 suggested courses. All courses are existing courses in MSU Denver catalog.² It should be noted that a 3-credits internship is required course. CareerWise and companies will help to locate internship opportunities for participating students.

This certificate uses existing courses in Engineering and Engineering Technology, Advanced Manufacturing Sciences, Industrial Design, and Communications. No new courses are needed for this certificate. From a technical perspective, the proposed certificate provides fundamental knowledge and practical skills for subtractive manufacturing and quality assurance concept for general manufacturing industry. With the certificate, a student should be able to start his or her career in mechanical or industrial engineering technician positions with a chance to move into quality assurance expert jobs or become lean manufacturing specialists. Also, since all of required courses can be applied to the manufacturing concentration of mechanical engineering technology program or advanced manufacturing science program, a student can come back to MSU Denver to pursue a BS degree in MET or AMS in the future. This certificate program has been approved by MSU Denver board of trustees.

Conclusion

Due to the changes of the industry, traditional college degrees may not meet the exact need of current industry. “Business and postsecondary education have found common cause in recent decades in the preparation of a highly skilled workforce to preserve the nation’s competitiveness and economic opportunity in response to rapid technological change and increasing global competition...The only way to develop curriculum and instruction models that deliver this skill set to large numbers of Americans is for business and education leaders to build collaborations that leverage their combined knowledge of labor markets, skills, pedagogy, and students.”⁷ The current university curricula may have most courses required in many cases. A purposeful redesign and rearrangement of existing courses with consultant with the industry may provide the education needed by the industry. Thus, curriculum innovation driven by industry inputs has become part of university curriculum development.

In curriculum driven by industry inputs, internship or coop opportunity is the common theme. Usually, the industry will provide this opportunity for participating students. This creates a win-win-win situation for all parties involved, the industry, the students and the university.⁸

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Biography

MINGLI HE, Ph.D. P.E., is an MET professor and chair of the department of engineering and engineering technology at MSU Denver. He has led and participated many new curriculum and course development including advanced manufacturing science institute (ASMI), construction project management, (CPM), computer engineering (CPE), environmental engineering (EVE), and sustainable systems engineering (SSE). He served as PI in Colorado helps advanced manufacturing project (CHAMP) and CO-PI in Denver Public School advanced manufacturing pathway project.

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