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Adapting Industry Based Curriculum Design for Strengthening Post Graduate Programs in Indian Scenario

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Abstract

Since last five years the demand for post graduate (PG) programs in Indian scenario are decreasing continuously year by year due to many reasons. The percentage of students opting for higher education, especially in Engineering domain hasn't increased from 2015-16 onwards. The expectations from today's graduates in engineering disciplines from the post graduate programs are high and much different from those of a decade ago. They expect a quality education from the institutes offering PG program with equal opportunities to interact with industries during their two years journey. Many PG programs in India have become obsolete in offering and delivering the post graduate program. These institutes have to reject the traditional approach of engineering education and have a paradigm shift to transform them in terms of delivering and improving the quality of teaching-learning process through adapting industry based curriculum design by fostering industry-institute collaborations. An attempt has been made to build a specific industry based curriculum model by introducing PLM and ERP (industry based) verticals in PG program by proper industry-institute collaborations at School of Mechanical Engineering. Two year PG program curriculum has been developed in consultation with leading PLM (Product Life Cycle Management) and ERP (Enterprise Resource Planning) companies. As an example for industry based curriculum design, the PLM course design has been considered in the paper. The program outcomes 3 and 5 (as per post graduate NBA norms) are attained through the design, development, delivery and assessment of PLM and related courses. The assessments in both theory and laboratory course are jointly done by teaching faculty and industry professional through appropriate assessment rubrics. Overall, adapting industry based curriculum model and frequent industry institute interactions are found to be beneficiary for students, faculties and industry professional.

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Keywords: Post Graduate Program; Industry Institute Collaborations; Product Lifecycle Management; Employability; Mechanical Engineering

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1. Introduction

The engineering education in India is getting transformed from last one decade. Many engineering education affiliated institutes are converting into autonomous institutes and slowly being promoted to private or deemed University status. It is also observed that, these institutes with autonomy and university status are bringing in many changes in their curriculum design, delivery and assessment patterns through continuous engineering education research and practices [1,2]. On the other side, there are many educational institutes in India offering engineering courses, especially post graduate programs in an old traditional approach without being upgraded. Such programs are being obsolete in today's engineering education environment and students seeking higher education straight away reject such programs. The student's enrollments in higher education, mainly in higher engineering programs are getting decreased year after year. The national enrolment proportions are found to be in the range of 23% to 25% since 2013-14 as per Gross Enrollment Ratio (GER) statistics. Although some innovative practices are observed in both undergraduate (UG) and post graduate (PG) program in the areas of course delivery and assessment patterns, there is a need to have a paradigm shift in curriculum design of Indian post graduate programs to sustain the future and compete with foreign Universities [3,4]. The engineering institutes offering post graduate programs needs to come out of comfort zone and have a disruptive curriculum and course design in the days to come. One such approach would be adapting industry based curriculum design with proper industry-institute collaborations.

Nomenclature

ERP	Enterprise Resource Planning
NBA	National Board of Accreditation
PG	Post Graduation
PLM	Product Lifecycle Management
PM	Production Management

1.1. Need for disruptive engineering education

The higher engineering education in India is not much emphasized as compared to UG programs. Sustainability of higher education programs has become a question mark in today's scenario. Most of the innovativeness in teaching-learning process and some sort of disruptive engineering education are observed mostly in UG engineering programs. But there is an actual need of disruptive engineering education in higher engineering education system through disruptions in student centric learning processes, industry-institute interactions and through proper design of curriculum and courses which are at higher level than that of UG programs. Disruptions in higher engineering education programs like M.Tech (Master of Technology) and ME (Master of Engineering) allows students to discover problems in industries and society and new ways of solving them by rejecting old way or approach to solve them. Disruptive engineering education engages students in more active learning process. It builds and prepares the workforce for the future.

1.2. Role of industries in engineering education

Knowledge alone is not a key factor for success for an engineering student. Skill set is another factor which is required for sustaining in today's industrial work environment. Industries keep complaining the educational institutes about the lower skill levels or lack of skill sets observed in engineering graduates across the country. Therefore, industries needs to join hands with academic institutes to strengthen the engineering course offered and prepare the workforce for the future as a part of social corporate responsibility. Involvement of the industries in academics will elevate teaching learning process, enhance problem identification and solving capacity of the students and the faculties, explore real life problems and improve the skill level of the students. Therefore, the framework for industry institute collaborations for designing the post graduate curriculum and courses, their challenges and benefits are explained and discussed throughout the further sections of the paper.

2. Framework for industry academia collaboration for curriculum design

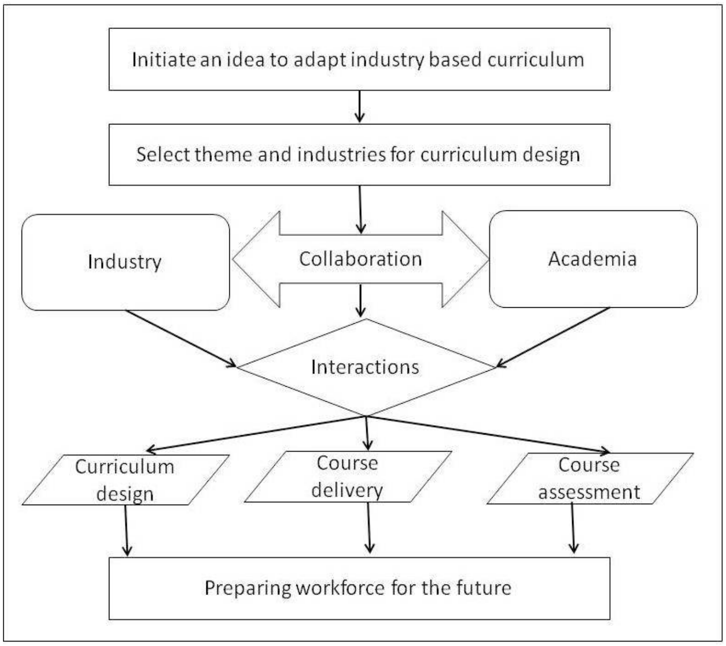

Fig.1 Framework for industry academia collaboration

Fig.1 indicates the framework for industry academia collaborations for curriculum design, delivery and assessment. Initially a theme based on recent trends in respective engineering domains suitable for PG programs has to be selected and accordingly the academic institute needs to short list and select the companies/industries for further collaboration process. Once the appropriate industries are shortlisted and selected, the institute needs to initiate the process of industry institute collaborations. There need to be frequent interaction with industry professionals with regards to curriculum design required for today's industrial scenario based on the theme (vertical) selected. After several rounds of discussions and interactions, industry and institute collaboratively needs to arrive at a particular curriculum design for two years PG program. Both curriculum structure and course design has to be completed six months well in advance before the start of the semester because the faculties of the academic institutes have to be trained by the industries on the recent curriculum contents during this period. Further, the industries need to involve themselves in course delivery followed by course assessment procedures. Delivery of the contents by the academic institute and industry professionals collaboratively is as important as designing the course.

2.1. Designing the curriculum using the framework

Two year curriculum was designed using the framework as shown in Fig.1 at school of mechanical engineering, KLE Technological University, India for the production management (PM) PG program during the academic year 2018-19. Initially, when the institute decided to adapt industry based curriculum, several themes based on recent trends and advances in mechanical engineering such as automation, quality engineering, PLM, ERP etc. were shortlisted. Further, after a detailed survey and proper literature review of the today's market condition, the school of mechanical engineering planned to choose PLM and ERP as the most suitable verticals for the PG program. Next, the institute selected some leading industries that are into these fields from several years. School head along with PG program coordinator and few faculty members interacted with industry representatives several times (Once in a week for three months duration) to design appropriate and relevant curriculum structure and course content for the students of production management PG program.

A two year curriculum structure with 88 credits was designed in consultation with leading PLM player Dassault Systemes and ERP supplier VedhaSoft Technologies. Dassault Systemes Foundation is one such organization which not only interacted with institute to design the course curriculum and content for two years but they collaborated with the institute for course delivery, assessment and various other academic purposes.

2.2. Collaborative course delivery and assessment

The industries collaborated not only for the curriculum design but also for course delivery and assessment procedures. The industry interactions with students for the purpose of course delivery in the form of guest lectures were scheduled for three times in a single semester for approximately 18-20 hours. Before the course delivery, faculties were trained by the industries on contents of the latest curriculum designed. Industries are expected to visit the University for three times in a semester, once during the start of the semester, once during the middle of the semester and finally during the end of the semester. During the beginning of the semester, the industry personal discussed the scope of PLM and ERP verticals in industrial scenario. They also motivated the students with successes stories in industries. The first visit of the industry guest lecture was the perfect kick start for beginning these courses. Further, for a period of eight weeks faculties carried out regular teaching learning process as trained up by the industries. During the second visit of the industry guest lecturer in a semester, they discussed important case studies, real time examples, implementation procedures related to PLM and ERP verticals in the industry. During this visit the doubts of the students solved by the industry representative. During their last visit towards the end of semester, the industry professionals were invited as the external examiner along with faculties in the department to evaluate and assess the progress of the students during. Industry experts conducted viva-voce to each individual student during the end of both 1st and 2nd semester to check and assess the knowledge and skill level of the students and they provided valuable feedback for their improvement accordingly.

3. Implementation of industry based curriculum design – A case

As mentioned in the earlier sections of the paper, both PLM and ERP verticals have been designed, delivered and assessed. But as a case study the curriculum design of PLM vertical, its implementation, delivery and assessment has been explained. The PLM curriculum design for the two year post graduate program has been shown in table 1.

Table 1. PLM Theory and Laboratory Course Design

Sl.No	PLM Fundamentals (2 credits)	PLM Advanced (2 Credits)	PLM Functional Lab (3 Credits)	PLM Technical Lab (3 Credits)
1	Introduction to Product Lifecycle Management	Deployment of the PLM System	Collaboration and Approvals	Variant Management Essentials & Product Architect
2	The PLM Environment	Challenges of PLM in Manufacturing Industry	IP Classification	Traceable Requirements Management Essentials
3	Product Life Management System	Service Industry and PLM	Engineering Bill of Material	Platform Management and Baseline Behavior
4	PLM in Different Verticals	Role of product Information Management in Collaborative Business Development	Project Management Fundamentals	Data Model Customization Essentials
5	Project Management in PLM Environment	Product and Product Management Strategy	Project Management Advanced	Web Based Customization

The theory courses have been split into PLM fundamentals and PLM advanced and similarly laboratory courses are split as PLM functional and PLM Technical. The contents of PLM theory courses and laboratory courses have been mentioned in table 1. It can be clearly observed the wide range of industrial applications have been covered in the industry based curriculum. The 1st semester theory course covers the entire fundamentals of PLM like need, its advantages, etc. The 2nd semester theory course is totally based on applications of PLM in manufacturing and service industries. Many industrial real time case studies were solved during the theory course delivery and the same was measured through end semester assessment. Similarly, 1st semester PLM Functional laboratory covers the hands-on experience on PLM basics using ENOVIA PLM tool. During the 2nd semester the lab is upgraded to a higher level with the contents of PLM configuration and PLM customization concepts. The configuration and customization part of the lab has been completely delivered by the industry experts. The laboratory exercises were divided as demonstration, exercise, structured enquiry and open-ended experiments [5,6]. Each student visited a nearby industry, collected data and worked on open-ended experiments using PLM ENOVIA tool. During the end of the semester, students presented their open-ended experimental work in front of industry experts.

3.1. Program outcomes and related indicators

Through proper implementation of PLM vertical industry based curriculum design, program outcome 3 and 5 are attained. There are totally three program outcomes for post graduate programs in India as defined by NBA and every program is free to add another two program specific outcomes based on the specialization. Program outcome 3 related to scholarship of knowledge is measured for PLM theory courses and program outcome 5 is measured for PLM laboratory courses. All the five program outcomes lead to particular competencies which are further split into performance indicators (PIs). These PIs are measured with the help of appropriate rubrics developed by the faculty incharge of the course. Sample PIs and competencies for program outcome 5 used for measuring PLM courses are shown in table 2.

Table 2. Program outcomes with related competencies and performance indicators

PO No	Program Outcome	Competencies	Performance Indicators
5	Ability to use and develop modern tools in modeling, simulation and analysis of manufacturing and management related problems	5.1 Acquire competence in modeling, simulation and analysis of real world problems using modern tools.	5.1.1 Identify appropriate tool and assess its compatibility for defined application
			5.1.2 Use relevant tool for solving an identified problem
		5.2 Develop customized solutions for existing problem through extensive analysis	5.1.3 Configure the tool based on required solution
			5.1.4 Customize the functions of the tool based on customer requirement

PIs 5.1.1 and 5.1.2 related to competency 5.1 are measured in PLM functional (1st semester) laboratory course, whereas, PIs 5.1.3 and 5.1.4 related to competency 5.2 are measured in PLM advanced (2nd semester) laboratory course. Demonstration, exercise and structured enquiry problems are measured using PIs 5.1.1 and 5.1.2. Open-ended experiments are measured using PIs 5.1.3 and 5.1.4.

3.2. Outcome attainments

The attainment of PIs 5.1.1, 5.1.2, 5.1.3 and 5.1.4 are found to be 92%, 86%, 75% and 66% respectively and is depicted in Fig.2. The initial demonstration, exercise level concepts in PLM ENOVIA software were found to be easy for the students to conduct and perform the exercise. The functional applications of PLM is hence found be strong among the students. Further as the complexity in the PLM lab increases from PLM functional concepts to PLM technical concepts, there finds to be the decrease in the attainment.

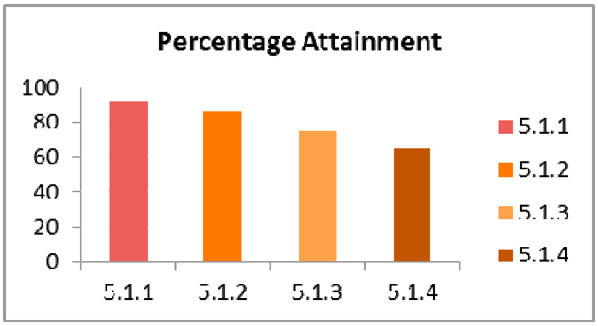

Fig.2 PI wise outcome attainment

The attainment of PI 5.1.3 is related to configuration of the PLM software and the attainment is around 75%, which is less compared to functional attainment. Further, during the customization of PLM software, the attainment of PI 5.1.4 has decreased to 66% because of the complexity of the open-ended experiments and structured enquiry approaches. The students are further trained on PLM customization and configuration processes with real time industrial case studies for better understanding of the concepts. The students further apply all the PLM ENOVIA modern tool concepts during their internships and project work. The overall attainment of PO5 is found to be 79.5%, which is a good attainment for the first batch of students opting PLM vertical. The overall attainment of PO3 in the theory courses was around 82%. Similarly, the theory and laboratory courses for ERP vertical have been developed, delivered and assessed.

4. Conclusions

As an example for industry based curriculum design, the PLM course design has been considered in the paper. As PLM is a wide subject, it has been split into two theory course and two laboratory courses over a period of one year followed by internships and capstone project for another year. The industry specialists were invited every month to deliver industrial case studies and enhance the student skills in PLM domain. The assessments in both theory and laboratory course are jointly done by teaching faculty and industry professional through appropriate assessment rubrics. The program outcomes 3 and 5 were attained through PLM theory and laboratory courses delivered. Overall, adapting industry based curriculum model and frequent industry institute interactions are found to be beneficiary for students, faculties and industry professionals. Similarly, courses for ERP and supporting courses are designed and delivered.

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