

## Curricular innovation: engineering management for global audience

**Purushothaman Damodaran, Promod Vohra & Omar Ghrayeb**

Northern Illinois University  
DeKalb, Illinois, United States of America

**ABSTRACT:** Engineers who grow to assume engineering managerial roles within an organisation need to be skilful in both engineering and management. Engineering management degrees are designed to hone these skills. This article presents a unique engineering management programme designed in the College of Engineering and Engineering Technology at Northern Illinois University, DeKalb, Illinois, USA, to cater to the needs of the emerging trends in the global market place. The highlights of the programme are discussed and a brief comparison with some of the well-known engineering management programmes is made.

**Keywords:** Engineering management, on-line programmes

### INTRODUCTION

The global market place for complex products and services has increased the need for practicing engineers to be competent in both engineering, as well as having management skills to provide technical leadership and make better engineering decisions. This need for engineers to integrate business skills with their highly specialised technical skills has resulted in an increasing demand for engineering management degrees.

A recent report by the American Society for Engineering Education (ASEE) indicates that enrolment in Master's degree in engineering management grew by nearly 115% between 2002 and 2011, while the total enrolment in Master's degrees in engineering remained almost unchanged during the same period [1]. Similarly, the number of Master's degrees awarded in engineering management grew by 84% during 2002-2011, while the total number of Master's degrees awarded in engineering grew only by 50% during the same period. The fact that 25.2% of the Master's degrees awarded in engineering management in 2010-2011 were to women compared with 22.7% of all engineering degrees awarded in 2010-2011 also indicates that Master's degree in engineering management is an effective strategy to recruit and retain more female engineers in graduate engineering degree programmes.

The increasing need for practicing engineers to have business skills and the corresponding increase in demand for engineering management programmes have resulted in a number of engineering providers across the USA offering engineering management degrees. Consortiums, such as the Master of Engineering Management Programs Consortium (<http://www.mempc.org/>) are also exploring the need to transforming practicing engineers into engineering managers. The engineering management specialisation at Northern Illinois University was carefully designed after a thorough study of similar programmes offered elsewhere. The programme is designed to cater to the immediate needs in the areas of engineering decision analysis and global logistics. With shrinking profit margins and growing competition from around the world, decision making and logistics are essential skills for an engineering manager to have. This article summarises and highlights the engineering management programme offered at Northern Illinois University.

### BENCHMARKING

Table 1 presents a comparison of several engineering management programmes offered across the USA. The table presents information on the universities offering engineering management programmes, duration (if published) to

complete the programme, number of credit hours required, mode of delivery (on-line, face-to-face, etc), areas of concentration (if any), and the name of the degree. From the table, it can be inferred that at least 30 credit hours is required to complete a Master's in engineering management and it can take anywhere from 13 months to 24 months to complete such degree programmes. Many universities are offering the programme on-line and some have both face-to-face and on-line options.

Northwestern University and Northern Illinois University have areas of concentration available for the students to choose from. The Northern Illinois University's programme is tailored to address the emerging needs in the areas of engineering decision analysis and global logistics. Most of the engineering management programmes require the students to take courses from business and engineering programmes. There are a few where the students are required to take courses from engineering. There are also some programmes which require students to take courses from engineering, business and law. A review of courses and contents in an engineering management programme can also be found in the article by Sun, H. et al [2].

Table 1: Engineering management programmes - a comparison.

University	Duration	Credit hours	Mode of delivery	Areas of concentration	Degree name
Johns Hopkins University	3 semesters	30	Face-to-face		Engineering Management
Massachusetts Institute of Technology	13 to 24 months	45	Face-to-face, On-line		System Design and Management
Cornell University	3 semesters	30	Face-to-face		Engineering Management
Case Western University	3 semesters	42	Face-to-face		Engineering and Management
Drexel	2-4 years	51	On-line		Engineering Management
Dartmouth University	18 months	42	Face-to-face		Engineering Management
Northwestern University		36	Face-to-face	<ul style="list-style-type: none"> <li>• Managerial analytics</li> <li>• Design and innovation</li> <li>• Project and process management</li> </ul>	Engineering Management
University of California - Irvine		54	Face-to-face		Engineering Management
Purdue University		33	On-line		Concentration in Engineering Management and Leadership
Ohio University	20 months	34	On-line		Engineering Management
Santa Clara University		45	Face-to-face		Engineering Management and Leadership
University of Southern California		30	Face-to-face, On-line		Engineering Management
Northern Illinois University	18 months	30	On-line	<ul style="list-style-type: none"> <li>• Engineering decision analysis</li> <li>• Global logistics</li> </ul>	Specialisation in Engineering Management

## ENGINEERING MANAGEMENT AT NORTHERN ILLINOIS UNIVERSITY

The engineering management specialisation at Northern Illinois University is carefully designed to equip engineers with appropriate tools and techniques so they can be an effective and efficient decision manager (i.e. engineering manager).

The students are required to take a blend of engineering and business courses. Figure 1 illustrates the curriculum. The engineering courses will equip the students with the concept of continuous improvement through data analysis (i.e. DMAIC - Six Sigma's systematic approach to problem-solving), project management, systems way of analysing problems and tools to analyse different, sometimes competing, projects. The business courses will equip the students to understand the fundamentals of accounting, financial management and the basic principles of management.

Depending upon the students' needs, they can elect one of two tracks to further specialise - engineering decision analysis or global logistics. With companies going global, it is important to understand the business uncertainties, logistical issues, etc, while making important decisions (both strategic and tactical). Decision making is an important function of an engineering manager. The decision analysis track will empower students to make effective decisions under uncertainty, and analyse risk and consider risk in making decisions. The global logistics track will empower students to make strategic and tactical decisions with respect to location of facilities, understanding the complex dynamics of different stakeholders in a supply chain, and design and optimise a supply chain.

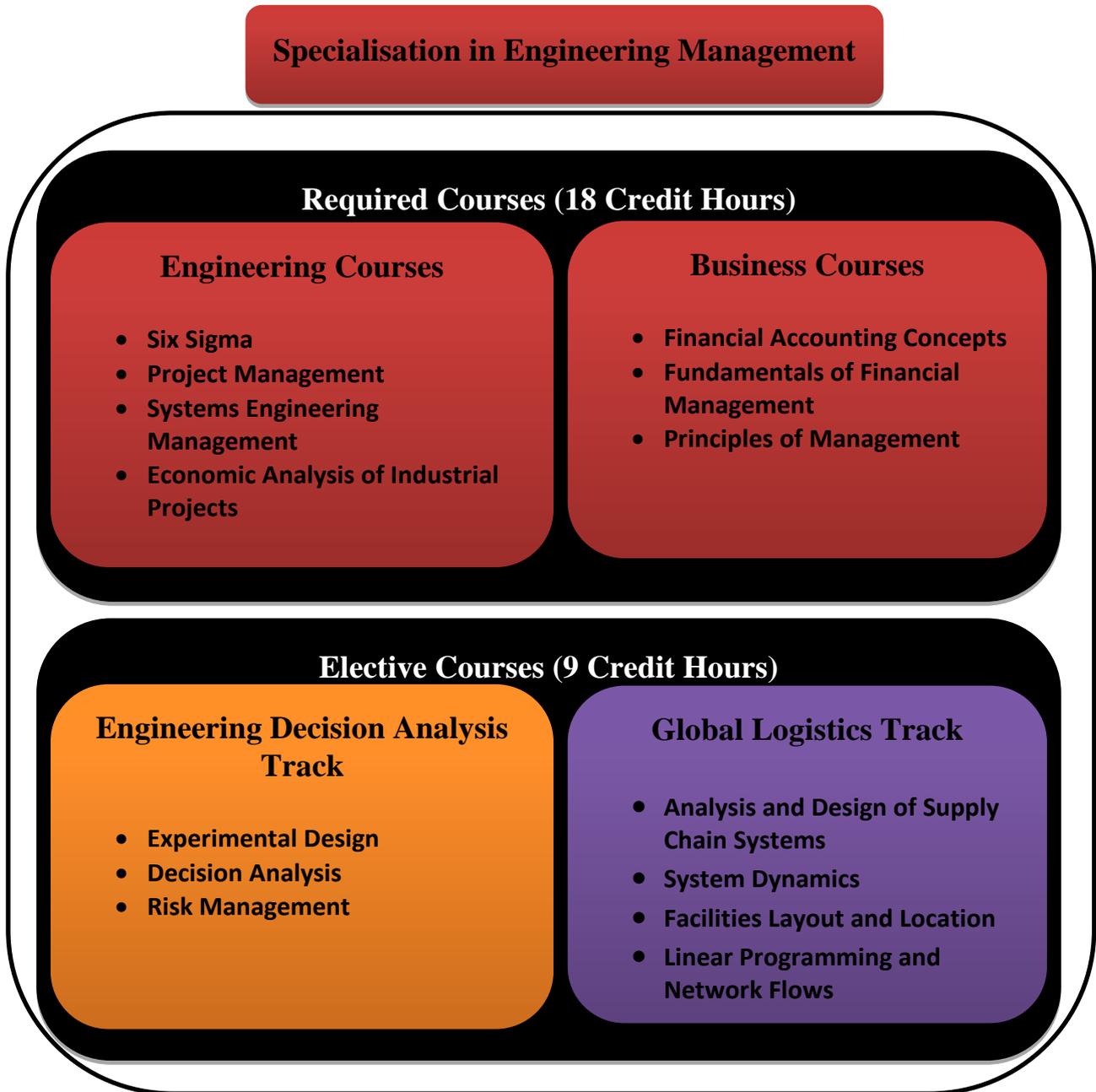


Figure 1: Engineering management curriculum.

In the engineering decision analysis track, emphasis is placed on tools and techniques commonly applied to make effective decisions. Topics from experimental design, decision analysis and risk management are taught under this track. Decision making under uncertainty is an essential skill that every engineering manager needs to possess. With uncertainty comes risk; consequently, understanding and analysing risk in decision making is key to become a successful functional engineering manager.

In the global logistics track, emphasis is placed on tools and techniques commonly applied to design and optimise a supply chain. In a supply chain, there are many complex interactions between stakeholders (e.g. suppliers, manufacturers, distributors, customers, transportation, etc). System dynamics is a useful tool for understanding the interactions and will help the decision maker in making profitable decisions while satisfying the various stakeholders' interests. Optimising a supply chain is essential to design an efficient system. Optimisation will be another important topic covered under this track.

After completing the course work, the students are required to complete a capstone project. The project will help the students to apply the tools and techniques learnt through the programme of study on real-life engineering management problems. The Department of Industrial and Systems Engineering and the College of Engineering and Engineering Technology at Northern Illinois University has working relationships with over 200 companies in the Northern Illinois region. These companies typically sponsor the capstone projects. This will facilitate students receiving experiential learning opportunities from the engineering management programme. Guest speakers will be invited to present at seminars on special topics and company visits will be arranged to expose the students to real life scenarios and how engineering management skills are practised.

The engineering management programme is being developed to cater to the needs of a global audience. Consequently, the courses will be offered on-line. The faculty members are trained to teach on-line and have prior experience in teaching some of the courses on-line. By offering the programme on-line, it is expected that engineers and those who will assume engineering managerial roles will be able to take advantage of their programme without any barrier based on their geographical location. Admission into the programme will be throughout the year. Two courses will be offered for each batch of students each semester.

## CONCLUSIONS

Engineering management programmes are gaining popularity. Both engineering and business skills are essential for an engineering manager to function successfully. The programme devised at Northern Illinois University is unique in that it emphasises the importance of skills in the areas of decision analysis and logistics. The success of this programme and challenges faced will be analysed objectively in the coming years.

## REFERENCES

1. Yoder, B.L., Engineering by the Numbers (2011), 18 June 2013, <http://www.asee.org/papers-and-publications/publications/college-profiles/2011-profile-engineering-statistics.pdf>
2. Sun, H., Yam, R.C.M. and Venuvinod, P.K., Education in engineering management. *J. of Engng Educ.*, 88, 2, 181-184 (1999).

## BIOGRAPHIES



Dr Promod Vohra is the Dean of Northern Illinois University's College of Engineering and Engineering Technology. His commitment to applied research and global engineering education is reflected in his work and philosophy. Dr Vohra has published widely and serves on several national and international committees and boards. He believes the engineering profession must act as an innovation catalyst and create a new economy for the globe.



Dr Omar Ghrayeb is the Associate Dean of Outreach and Undergraduate Programmes of Northern Illinois University's College of Engineering and Engineering Technology. He works closely with the industrial sector and spearheads the EIR programme. He is committed to promoting experiential learning as part of engineering education and works with several companies in the area to bring real-life projects into the classroom. His expertise is in process innovation and production planning.



Dr Purushothaman Damodaran is the Chair of the Department of Industrial Engineering at Northern Illinois University's College of Engineering and Engineering Technology. His research and teaching interests are in optimisation, simulation, scheduling, logistics and manufacturing. He is engaged with several local companies and distribution centres in promoting experiential learning opportunities for the undergraduate and graduate students in the Department.