Engineering Management: A global review

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- All my colleagues and friends who were critics of this research.

Abstract

The current trend in most industrial or engineering companies is engineers becoming managers or leaders. Engineers or technicians may serve longer in an institution or company as opposed to their counterparts in other industries. The trend applies to the engineering industry in general. Experience is a cause for succession to senior levels in this industry, and achieving satisfactory levels of competency takes a minimum of five years.

As technology progresses, the Original Equipment Manufacturer (OEM) introduces advanced complexity with its equipment designs. Technical organisations have expanded in-house skills and, in turn, the responsibility of the employees broadens and becomes complex. Typically, within the South African technical industry, the engineer moves into management by promotion while possessing excellent technical skills, but generally with limited financial, marketing, and people management skills. It is valuable for both the individual and the industry for an engineer to assume a leadership position. Technical expert skills are favourable when buying complex and high-tech equipment. The engineer with a deep understanding of the industry and experience contributes significantly when a company is selecting required equipment.

When an engineer's role changes to the manager, the challenges for him or her are to deal with new problems and present different solutions for the organisation. These problems may range from managing teams to understanding people from work-related to human issues, to defining equipment and tools to use within the scientific organisation, but understanding the international industry as opposed to the local South African engineering is essential.

The purpose of this study is to analyse the University of Johannesburg's course development in its Engineering Management postgraduate degree. The approach was to select some universities against which to conduct a benchmark study. The universities chosen were the South African universities, members of Universitas 21, and universities affiliated with the American Society of Engineering Management. The University of Johannesburg is the baseline for the research, against which the Engineering Management delivery methods and the modules offerings.

The framework from the University of Johannesburg allowed the researcher to group the data collected comparatively. The evidence from the result reveals the pattern that engineering management is the leading study field at Master's level in the universities evaluated. The modules revealed the skills set needed by engineering managers with a regular pattern as well. The study concluded that the University of Johannesburg's Engineering Management course is on par with the world's best institutes.

The research determined that the University of Johannesburg establishment of engineering management to be solid. The study showed the relevance and delivery technique of engineering management is in line with the rest of the universities studied. The degree grading at the postgraduate level is the trend of prominence globally. The skills set offered academically by the University of Johannesburg is in line with the best practice. Engineering Managers are set for success when equipped with the knowledge (and applications thereof) gained at Master's level. Therefore, the relationship between management and engineering strength lies with the knowledge base of engineering management.

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List of Abbreviations

B. C.	Before Christ
MRO	Maintenance, Repair, and Overhaul
UJ	University of Johannesburg
Dr	Doctor
ECSA	Engineering Council of South Africa
OEM	Original Equipment Manufacturer
EM	Engineering Manager
SA	South Africa
UP	University of Pretoria
UCT	University of Cape Town
ASEM	American Society for Engineering Management
SUN	Stellenbosch University
NWU	North-West University
MBA	Master of Business Administration
UNSW	University of New South Wales
UBC	University of British Columbia
MU	McGill University
LuUni	Lund University
UMR	University of Missouri-Rolla
UoA	University of Auckland
USA	United States of America
UoD	University of Delhi
NUS	National University of Singapore
UCD	University College Dublin
PUC	Pontificia Universidad Católica de Chile
OSU	The Ohio State University
UHK	University of Hong Kong
UoB	University of Birmingham
UoE	University of Edinburgh
UoG	University of Glasgow
UoN	University of Nottingham
PhD	Doctor of Philosophy
MPhil	Master of Philosophy
BS	Bachelor of Science

MS	Master of Science
ME	Master of Engineering
U21	Universitas 21
DPhil	Doctor of Philosophy
EMBOK	Guide to the Engineering Management Body of Knowledge
Pr Eng	Professional Engineer
Pr Tech Eng	Professional Engineering Technologist
Pr Techni Eng	Professional Engineering Technician
Pr Cert Eng	Professional Certificated Engineer
MOOC	Massive Open Online Course

Chapter 1

Introduction

The term Engineering Management refers to the joining of specific knowledge with the science to manage people and assets within an engineering firm. At the point the engineer manages the work of individuals, the engineer is experiencing the first period of engineering management. The primary duty is to lead a team in creating a yield consistent with the needed specifications of the organisation (Chang, 2005). The skills needed by engineers in delivering as managers are subject to review, although universities offer diverse coursework in the form of modules that relate to industry-specific projects. Looking beyond training, reaching emotional intelligence is a fundamental challenge to an engineering manager's skill.

The engineering features have transformed to the primal reason in the global market. Under fervent competing environments, engineering managers battle to reach saleable results by concentrating on turnaround time, excellence, and cost. Arriving at these targets can only be by effective planning, organising, departmental integration, people skills, and firm integration of new knowledge (Dhillon, 2002).

The skills developed in formal qualifications are fundamental to the delivery of an engineering manager. Universities focus on various core and none-core material to develop the skills of an engineer with the potential to evolve him or her into an engineering manager.

1.1 The Historical Development of Management

Market pressures encourage engineers with managerial positions to understand the management roles for success while organisations fight complacency. The education earned at the undergraduate studies needs expansion for an engineer to be ready to take on the economic challenges of this era (Goh and Bullen, 2010). As Srinivasan (2014) summarises, engineering management is an old philosophy. The idea did not begin with engineering management, as the events in Figure 1 describe. According to Chang (2005), engineering management evolution will turn into something big as the industry changes, for example, with Industry 4.0 (Matthias, B. and Richard, K. and Robert, M. and Dominik, W, 2016).

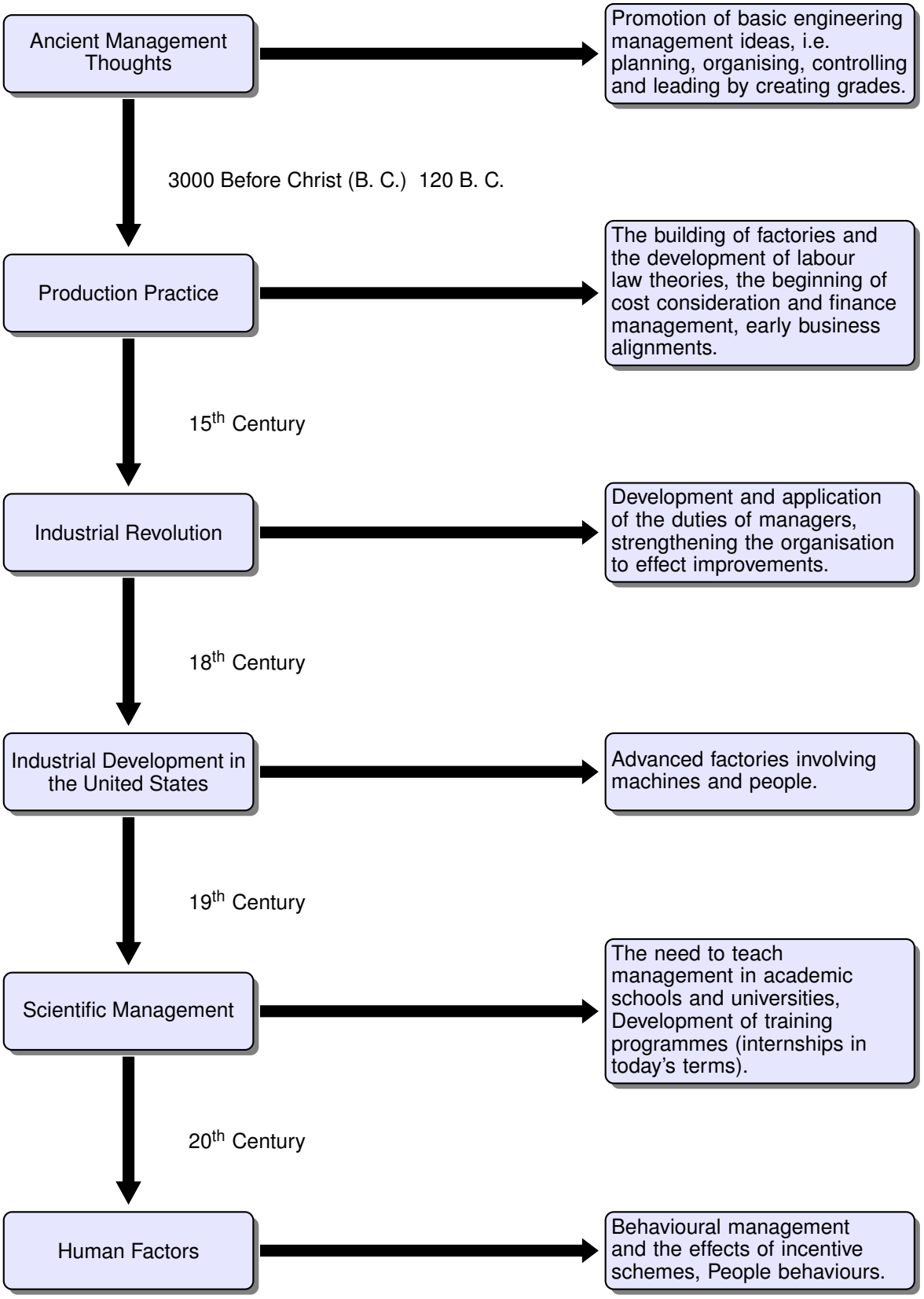


Figure 1: Historical Evolution of Management (Chang, 2005)

1.2 Problem Statement

Engineers who evolve into managers have to understand the intricacies involved before assuming the role of manager. Success in management is dependent on the engineer's improving his or her people skills, communicating with management colleagues, being techno-savvy with applicable Internet and computer-based tools, and understanding organisational roles (Chang, 2005).

The skills development of engineers focusing on engineering management or technical development is through postgraduate courses. The effectiveness of these courses to deliver the suitable skills is a challenge. The University of Johannesburg (UJ) conducts one of the largest Engineering Management programmes in South Africa (SA). Considering the recent programme evolution in line with South Africa's demands, Universitas 21 (U21) and global best practice.

The worlds of business, management, engineering, and technology are ever-evolving. Universities have to regularly analyse and evolve course content to align with the needs of industry. The skill set development for engineering management is also subject to this analysis.

1.3 Impact of Engineering Management in a Business

The primary duty of the technical executive is always to take care of organisational development and course of action, not just have a simple understanding of technology. An understanding of the needs that underpin the particular inspiration of specialists and staff are necessary. Guides are available to decide the tasks of engineering management in the various specialised industries, as the varieties of engineering have implications (Liang, 2012).

1.4 Research Objective

- Review of South African universities, Universitas 21, American Society for Engineering Management (ASEM) and Global Engineering Management offerings.
- Conduct a detailed analysis of engineering management offerings globally, relative to the University of Johannesburg.

1.5 Research Question

Q1: What are the current global universities offering Engineering Management and in what formats?

Q2: What are the specific skills and courses defined by international best practice, unique to Engineering Managers?

Q3: What are the trends in Engineering Management offered by universities in South Africa (SA) and globally?

Q4: What makes UJ relevant in offering an Engineering Management degree?

This study seeks to find solutions for the future based on the current problems faced by the Engineering Manager (EM) after assuming a management position by following using a research procedure. Before setting out the details of research approach and methods, it is proper to introduce a research process summary.

1.6 Research Process

To effectively carry out the research, a procedure with a sequence of steps as illustrated in Figure 2.

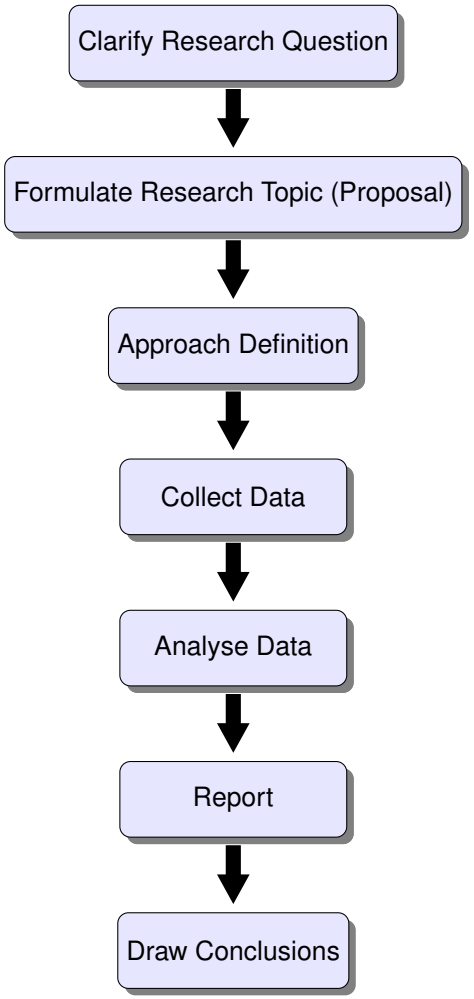


Figure 2: The Research Procedure (Cooper and Schindler, 2013)

1.6.1 Clarification of Research Question

The engineering profession has advanced over the past couple of years, and engineers' limits are not individual tasks of support only. The engineer's particular engagement is more capturing and, allows the engineers presume much larger roles using higher organisational objectives (Federation, 2015). It is common that engineers advance to a career in management once they have progressed to a satisfactorily level in their engineering jobs.

1.6.2 Define Approach

In conducting research, the researcher must show the ideas of available studies to the topic (Saunders *et al.*, 2009), and have a clear research design and understanding of how to collect and analyse data. Early on in the research project, it needs to be clear what the researcher is doing, and why he or she is doing it. The research must be aware of the associated implications of his or her findings.

1.7 Conclusion

Engineering firms and universities should look into the education content and methods available for delivery of engineering management. These have to equip engineers who aim to be managers with correct and current skills. Engineers who are managers need to grasp worldwide markets related to the items or services with which they are concerned. To survive and succeed in the future, the engineer needs the skill to manage until the globalisation changes reach new harmony.

The next chapter is the literature review on engineering management. This review is from historical studies on engineering management and roles of engineering managers. The change of engineering field as a whole may be a discovery. The working together of academia and industry is key to the success of engineering managers (Goh and Bullen, 2010).

Chapter 2

Literature Study

One critical motivation behind surveying the literature for research is to hone the centre of the underlying research interest and the particular way in which the researchers plan on using the literature to lead a study (DePoy and Gitlin, 2013).

In industrial organisations, engineering, maintenance, and management are considered as a cohesive unit to accomplish the end goal of equipment maintenance (Kinnison, 2004). The discussion into a level of detail around the skills developed by engineering management courses will is in this chapter.

2.1 Engineering

As defined by Lamb (2013), engineering is an art that applies logical information to the fields of material science and science, materials, arithmetic, and rationale to oversee real business issues. Engineers utilise the results they obtain in the investigation of logical and numerical principals to fabricate, outline, and form concrete answers to issues.

According to the Engineering Council of South Africa (ECSA), engineering is the act of science, designing science and innovation concerned with the arranging of matters of financial significance and those fundamental to advancing society. The results are dependent on primary, logical, mathematical and engineering data. Usually, results depend on examination and amalgamation, supported by the sound techno-financial investigation. Solutions must weigh the needs of society with manageability and the indemnity of physical surroundings. The ECSA dictates the engineering work, administration and correspondence and must lead morally and inside the limits of the legislation (Engineering Council of South Africa, 2015).

Engineering is managing the unknown, according to Fleddermann (2011); he says one wellspring of the moral issues experienced over the span of engineering practice is an absence of knowledge. Managing the unknown is in no way, shape or form an abnormal circumstance in engineering. Engineers regularly experience situations in which they do not have the greater part of the data that is required.

2.2 Engineering Management

Each item designed by man needs observation and non-stop upkeep to guarantee performance in its proposed work. Since systems, equipment and services function in an engineering domain, and they are thought to change with man's typical presence, it is central to prepare people and the context to support repeat inspections and repairs (Aubin, 2004).

The professional engineering career has changed over the past few years. Technical engineers are not in a sole duty of support only. The engineer's guidance is far more reaching, and so they assume broader roles with larger organisational goals. The engineering manager will deal with scientific methods, as well as assignments to lead by building worth to help overall corporate performance (Chang, 2005).

According to Dhillon (2002), an engineer has remarkable qualities, and some incorporate enjoying new and diverse experiences. Engineers are independent and can exercise technical knowledge and skills with other engineering experts to tackle problems.

Engineering management is managing engineers and their roles and applying the acceptable methods of fulfilling management roles (Morse and Babcock, 2013). Engineering management roles involve using different assets within and external to the organisation (O'Connor, 2005).

Competent engineers who are managers must gain management skills. Engineers get close to 10,000 hours of learning in their formal training sessions to get their first degrees in engineering. This formal training equips them with special aptitudes in various engineering areas, on design, and on the execution of projects. Minority of engineers receive formal college training on management, and most have business management, not engineering management. There are particular aptitudes and learning needed to keep in mind if the end goal is to be a seasoned engineering manager (Aster, 2008).

The portion of the manager varies from that of the engineer. The manager has far-reaching interests in the business and does not have the profundity in any of the interests. Management routinely concentrates on different needs, juggling assets, and dealing with the daily undertakings of the business. The engineer needs to focus on the advancement of jobs and have a large measure of profundity in these ranges. He or she needs a resolute centre to finish the programme on time and cost (Annacchino, 2003).

Real predicaments in making a move from the technical engineer to the manager are innate in the contrasts between these two parts, see Table 1 (Chang, 2005).

Table 1: Role Differences between Engineers and Managers (Chang, 2005)

Characteristics	Engineer	Manager
Focus	Technical or maintenance jobs.	Interested in staff and strength.
Decision Making Basis	Enough information with great certainty.	Unclear Indistinct data to come to a conclusion.
Involvement	Individual worker, develops technical policies.	Decides role of others to meet targets.
Work Output	Various set targets.	No set targets besides finances.
Effectiveness	Depends on technical expertise and own initiatives.	Relies on communication, leadership skills, completes tasks through people.
Dependency	A great degree of independence.	Cannot perform alone, reliant on others.
Responsibility	Only one job before the other.	Tracks various targets simultaneously.
Creativity	Scientifically and technologically focused.	Better with human management.
Bottom Line	Performing as expected.	Performing tasks to achieve company's objectives
Concern	Technical failures.	Product acceptance in the market and contributions to the industry at large.

2.3 Engineering Management Knowledge Domain

Engineering management is the stage that speaks to the move from the technical thinking to the act of management thinking, with the skill to integrate. Not all engineers regard this as an easy move, but some consider this as an opportunity to gain experience. Management skills are key in this phase (Lannes, 2001). As career development takes its course, universities offer courses in alignment with Guide to the

Engineering Management Body of Knowledge (EMBOK).

- **Management and Leadership** Understanding management and team behaviours, while gaining communication and motivation skills.
- **Financial Management** Financial Decision Analysis
- **Engineering Project Management** Project Management techniques, controlling risks and managing conflicts within project teams. Managing the Project Management Office.
- **Marketing** Product development and market research, staying current with the consumer needs.
- **Systems and Decision Making** Developing tools to enable the use of computer applications to improve business models.

According to Shah *et al.* (2015), it is important for an engineer to have necessary skills when assuming management positions. Universities, organisations and engineering managers need to note of EMBOK, which provides a list of knowledge domain that will aid in developing the curriculum in engineering management, and best industry practice for engineering managers. The list is as follows (Shah *et al.*, 2015):

- Market Research, Assessment and Forecasting
- Strategic Planning and Change Management
- Product, Service and Process Development
- Engineering Projects and Process Management
- Financial Resource Management
- Marketing, Sales and Communications Management
- Leadership and Organisational Management
- Professional Responsibility, Ethics and Legal Issues

2.4 Functions of the Engineering Manager

Management from the engineer's view is close to industrial engineering (Maynard and Zandin, 2001). The concentration is on what happens to humans, not equipment. Engineering management varies from general management in that it has experts in specialised fields (Nel, 2007). According to O'Connor (2005), engineering management involves both managing skills and applying technical knowledge in the career of an engineer.

According to Hill and McShane (2007), management is the ability to complete tasks through staff. Managers do not bear behaviours of bureaucrats; usually, they accomplish more than simply keeping the trains running on time. Managers can equally give businesses a feeling of reason and bearing.

Management, as a general term, is when individuals unite to achieve objectives and goals of the organisation (Schlais *et al.*, 2011). Now and again, the term management is stretched out to include the control of non-human assets.

Management is an unending cycle (Nieuwenhuizen *et al.*, 2008), see Figure 3, and feedback is a critical step of the procedure. The discussion is as follows:

- Planning
- Organising
- Leading
- Controlling

It is an anticipation that future intensity of associations will accentuate task groups and network structures. The movement of engineers to management occupations in assembling plants will become standard. The move of an engineering specialist from a technical role to a managerial position prompts a dramatic change in time usage to the highest ability where information is concerned (Kahraman and Onar, 2015).

Figure 3: The management process (Nieuwenhuizen *et al.*, 2008)

2.4.1 Planning

Planning entails ensuring a plan is in place to meet the target of the organisation. The decision on the steps to meet the objective remains with the engineering manager. Planning makes it easier to perform tasks correctly (Morse and Babcock, 2013).

Planning is a phase in management. In simple terms, to plan implies deciding the future position of the business and choosing the procedures expected to achieve that position (Nieuwenhuizen *et al.*, 2008).

2.4.2 Organising

Creating an environment suitable for a human to work in is the fundamental law of organising. It includes coordination within the organisation with the aim of outlining who is doing what and the how to do

the job. It does not include overstepping on other employees jobs with regards to communication and accountability (Chelsom *et al*., 2005).

An engineering manager entrusted with responsibility needs to realise that the sustainability of the business is reliant on coordination towards the achievement of a common set of goals and decisions on who within the organisation must do what and when (Hill and McShane, 2007).

2.4.3 Leading

On conclusion of planning and organising, the company empowers employees to perform the task by plans to achieve the objective (Dhillon, 2002).

Leading is uncomfortable for engineers aiming to be managers. According to Wellington and Foster (2009), corporate success focuses on the connections between manager and the teams they lead, through managers and engineers cooperating. Hill and McShane (2007) define leading, as the way of propelling, influencing and guiding others in the association to work satisfactorily for business objectives. Leading involves voicing an excellent critical vision for the business and turning into a bold supporter of that idea.

2.4.4 Controlling

Controlling involves promoting performance and simplifying the results of the organisation (Chelsom *et al*., 2005). Without supervision, it is not easy for employees to perform tasks, therefore, controlling is a key management responsibility. The engineering manager must draw up measures to ensure achieving targets, thus, with this formula, realising control. An essential part of controlling is measuring progress towards the goal and making a move towards recovery when fundamental challenges arise. Encouraging opinions is central to control and serves as a contribution for the arranging procedure (Nieuwenhuizen *et al*., 2008).

2.5 Engineering Manager Competencies

According to Lannes (2001), engineers have a career path into management, defining what engineering managers do in their daily occupancy. The stage speaks to the move from scientific thinking to management thinking, which needs the skill to integrate, see Figure 4. Not all engineers regard this as a natural move; others consider this as an opportunity to gain experience.

Management skills are essential in this phase. The skills and abilities needed for this period of development are project management, personnel and communication, skills in finance and marketing (Lannes, 2001).

A statement, according to Chang (2005), is that engineers inspired by moving into authority positions need to realise what it takes to be a leader. The success when the engineers accept management position is mastering skills in human relationships throughout all levels of the organisation. Notwithstanding the use of the web-based application for managing departments, computer applications are used to foresee innovative ideas. The engineering manager must uphold the vision for

the organisations they work for, and have the required business tact with a client centre and a global focus. Innovative thinking is core to the product and the services offered.

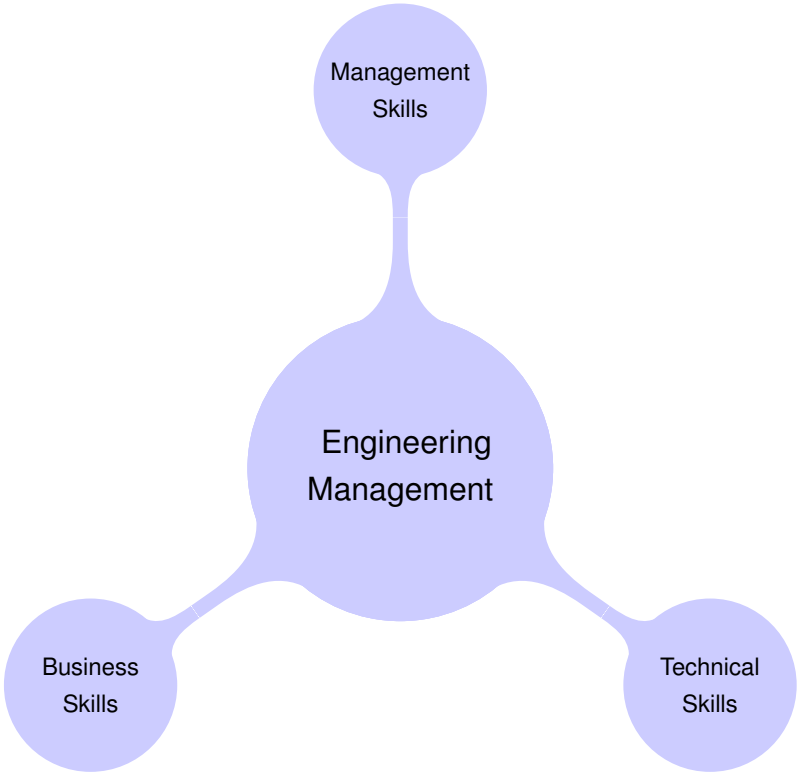


Figure 4: Classical Engineering Manager's Skills (Chang, 2005)

As the industry develops gradually, the significant notice on the technology changes, with the likes of smartphones, smart cars to mention a few. Universities are preparing engineers for management positions with engineering management courses with different curricula. These curricula may need a further review to align with Industry 4.0 ideas.

2.6 Describing the Roles of Engineering Manager

2.6.1 Management of Finances

In his book, Eschenbach (2011), states that accounting information is used to estimate capital hardware and production versus buying choices. While accounting is also critical in government, this discussion concentrates on the private firm for clarity. Accountants track the expenses of tasks, products, and regularly give fundamental information to support engineering investigations. Following these expenses (and incomes) are assessments of future occasions.

The engineering economy, accounting, and managerial roles work in harmony from multiple points of view. In large firms, it is normal to discover these competencies by distinct divisions inside the firm, contrary to small firms where the task a central to an individual or group of people.

- The engineering economics analysis incorporates distinguishing and finding out tasks and choices

and evaluating their financial influence over their life cycles.

- Accounting incorporates representing the dollar influence of past choices, financial reasonability of a firm and recognising and assessing subsidising sources.
- The managerial role is to evaluate the overall performance of the organisation and streamlining the business to realise profits. Managing the financial conditions and performance is critical in this role within the organisation, and the full use of assets.

Figure 5 draws the association between the accounting, management, and engineering economy skills. It underlines the necessity of trade of information and correspondence.

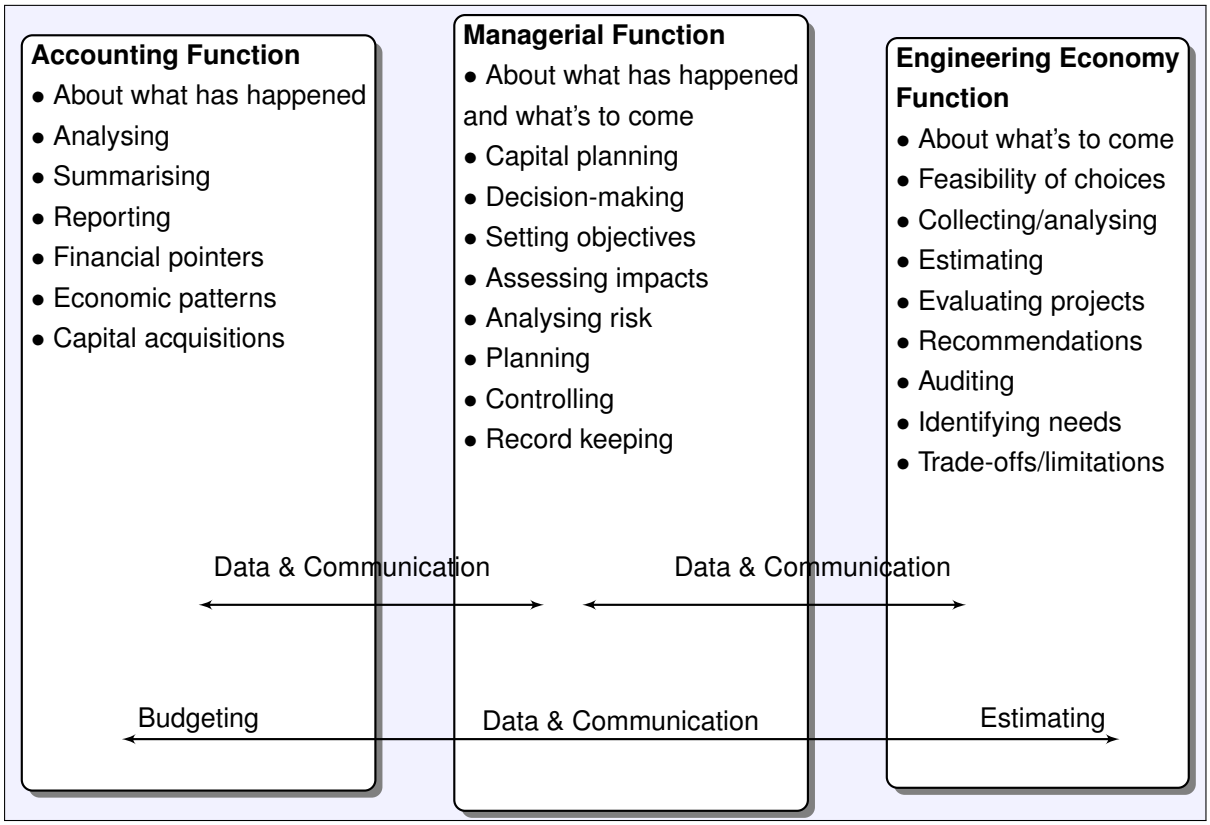


Figure 5: The accounting, managerial, engineering economy roles (Eschenbach, 2011)

The financial view in civil engineering associations depends on the business managers. Engineering managers are expected to look at the economic analysis beyond the bounds of current projects (Chinowsky and Meredith, 2000).

To seek the support of Executive Management, engineering managers need to create and display their projects as rewarding, rather than losses. Engineering managers do calculations to present possible profits. The calculations are a sound approach to quantify a project by using techniques from the Engineering Economics Management Course.

In support of the financial reasoning, Garside (1999) states that the engineer's assignment is now to guarantee the prescribed changes or project endeavours through financial benefit and the proposed

project and business and financial measures set up at the beginning of the project. This check is against the market campaign, with executive management confirmation of capital to complete the project.

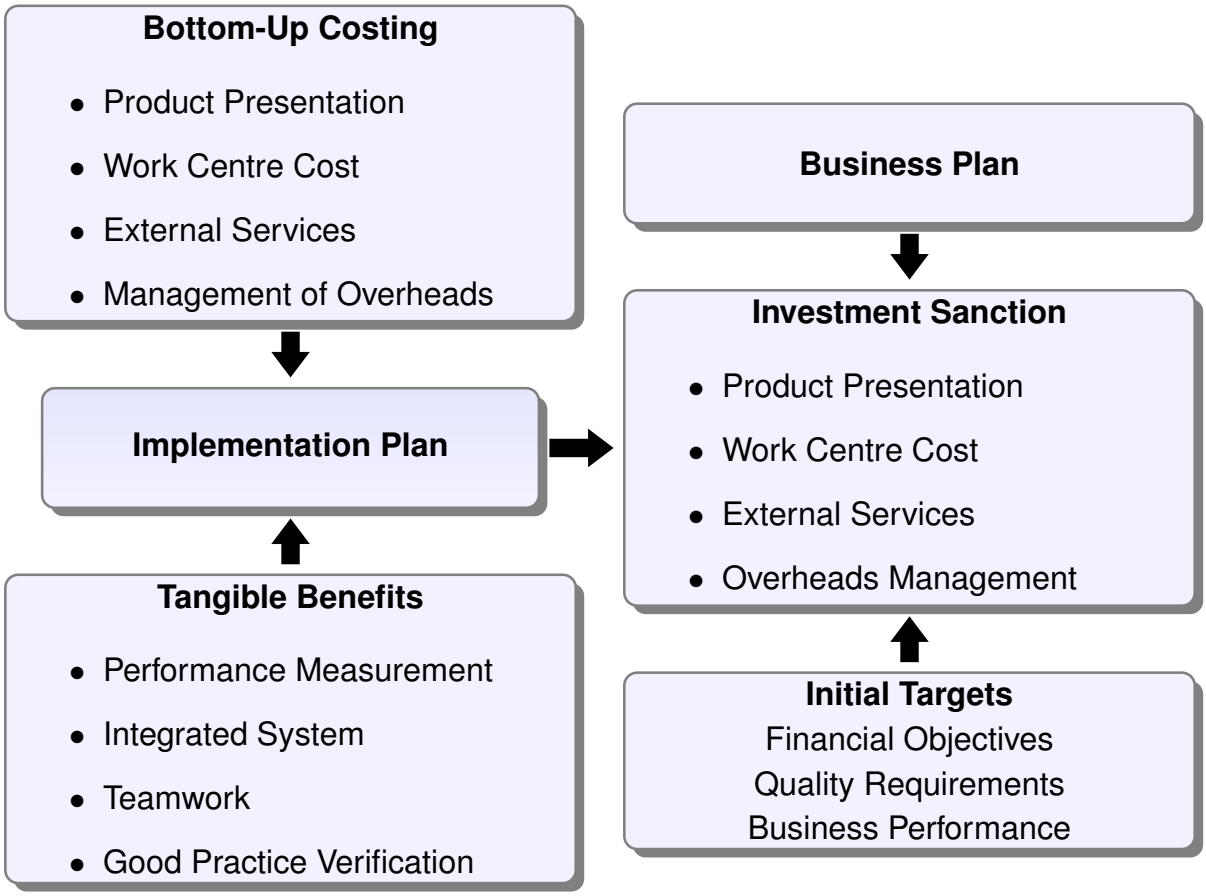


Figure 6: Preparing the Business Case (Garside, 1999)

2.6.2 Management of Engineers

To manage engineers is different to other industries since engineers often have high achievement in formal academic instruction. Engineering managers must be mindful of the effects of their role in leading specialists and professionals (Liang, 2012).

A worker's lifecycle covers the journey workers experience from the time of employment in a company until they leave. Human asset experts regularly centre their consideration on the means in this journey with expectations of affecting the association's main concern. Usually, they will probably decrease the association's cost by a worker employed, which theoretically is something beneficial. The reduction of employees is not a goal as human assets experts are not the ones who can make workers stay energised, and be a profitable company (Gulati, 2013).

According to Gulati (2013), workers are one of an associations biggest costs nowadays. Unlike other real capital costs, for example, equipment, and technology human capital is unpredictable. Managers are in key positions to lessen that unpredictability by decreasing the general life cycle cost of workers in the company. This life cycle comprises of four stages:

- Hire
- Inspire
- Admire
- Retire

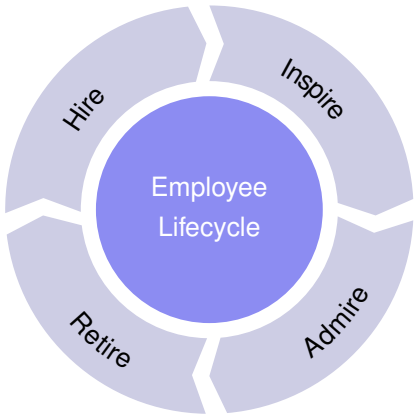


Figure 7: The Employee Lifecycle (Gulati, 2013)

Engineering managers and recruitment experts who employ skilled, specialised and expert employees can approve the interest of the best individuals. The approaches to creating a powerful business mark are also diverse when managing individuals from these groups. Recruiting the best candidates for specific occupations needs a creative staffing and selection method (Rothwell, 2011).

According to Aubin (2004), the recruitment role influences the power of the maintenance role to bear out its business in the Maintenance, Repair, and Overhaul (MRO) industry. The recruitment and selection role guarantees that people chosen possess the required skills. They also start carrying out surveys and salary changes, see Figure 8.

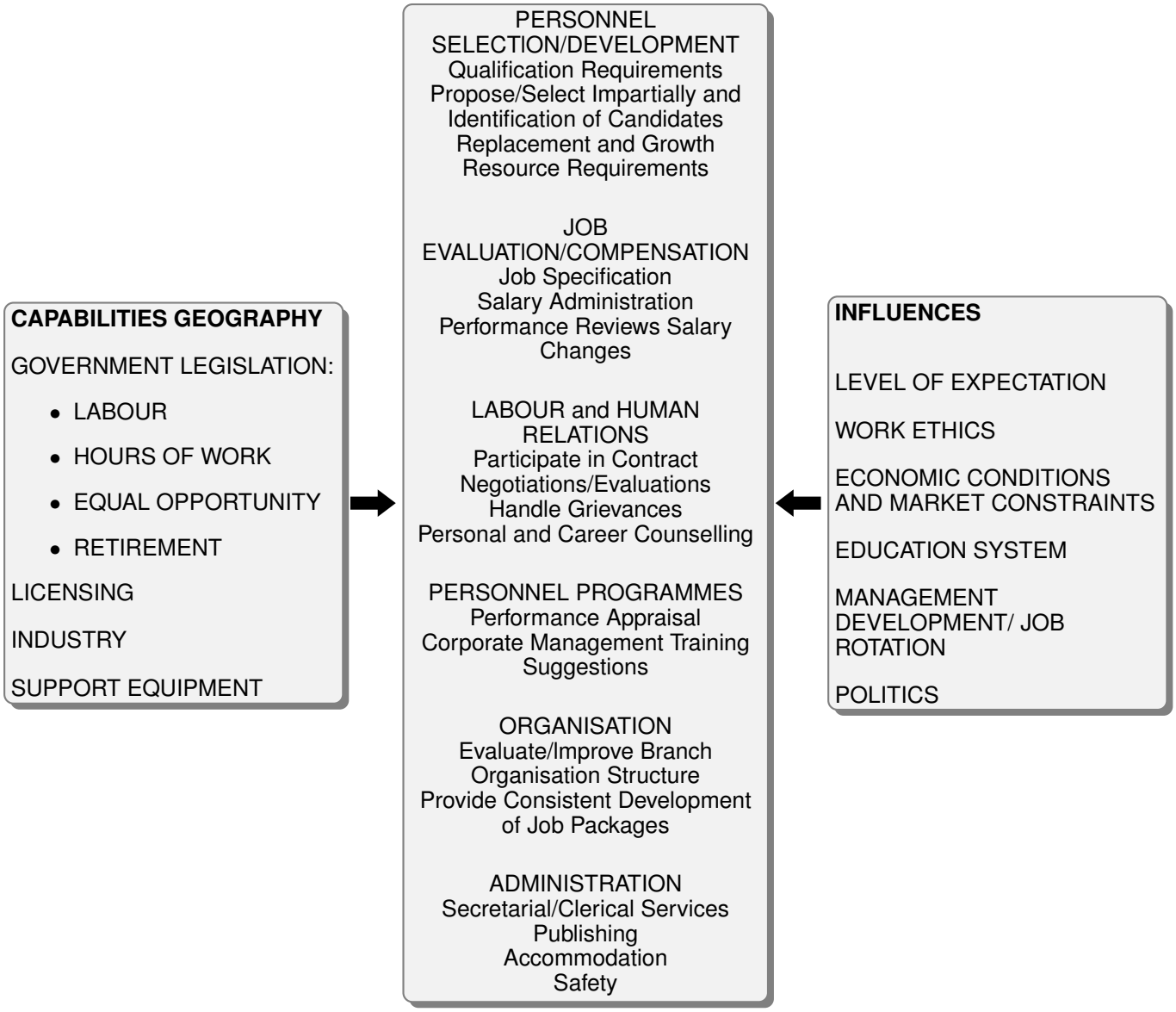


Figure 8: The human resources function affects many engineering firms (Aubin, 2004)

2.6.3 Management of Projects

Project Management

Today's officials understand the answer to corporate issues, picking up control and use of existing assets, and looking within instead of remotely for the solution. As a part of the effort to realise an inner solution, senior managers are exploring the ways to manage corporate undertakings. Project management is one of the methods considered (Kerzner, 2013).

Project Manager Role

According to Kerzner (2013), the project manager's role is in planning and coordinating. The joining exercises performed by the project manager include:

- Coordinating the actions critical to developing a venture plan
- Incorporating the key events needed to satisfy the plan
- Incorporating the actions critical to take off changes to the arrangement.

The mixing of roles appears in Figure 9, where the project manager must change the sources of information (that is, assets) into yields of products, administration, and, finally, benefits.

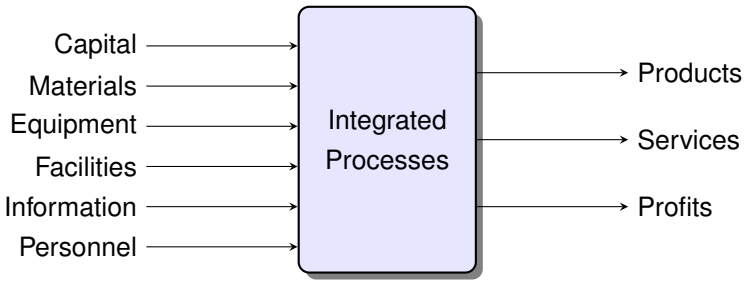


Figure 9: The Integration Management (Kerzner, 2013)

With a specific end goal to do this, the project manager needs solid, informative abilities. Project managers must be comfortable with every line department roles, and the technology in use (Kerzner, 2013). Most engineers land up overseeing projects without even noticing that they are doing so. Inevitably, these engineers perform a task that is in the scope of project management. Before commencing any projects, engineers must describe a plan to guard against failures (Heagney, 2016). Since projects are not permanent, with clear beginnings and finishes, they follow the procedure, as set out in Figure 10 (Dobson, 2015).

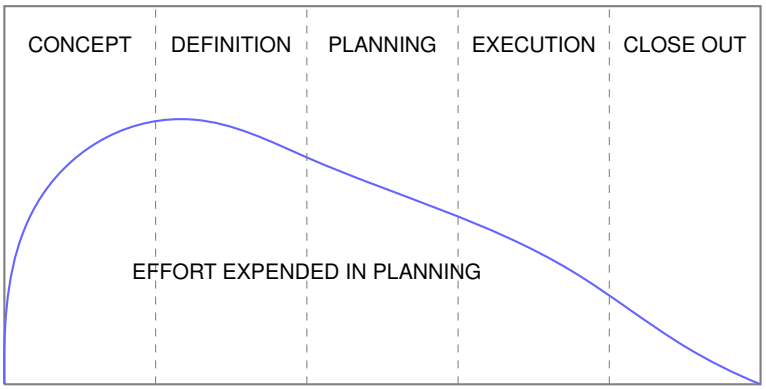


Figure 10: The Five Project Management Process Groups (Heagney, 2016)

When the engineer is to manage the project, the following method is set out by Heagney (2016), see Figure 11.

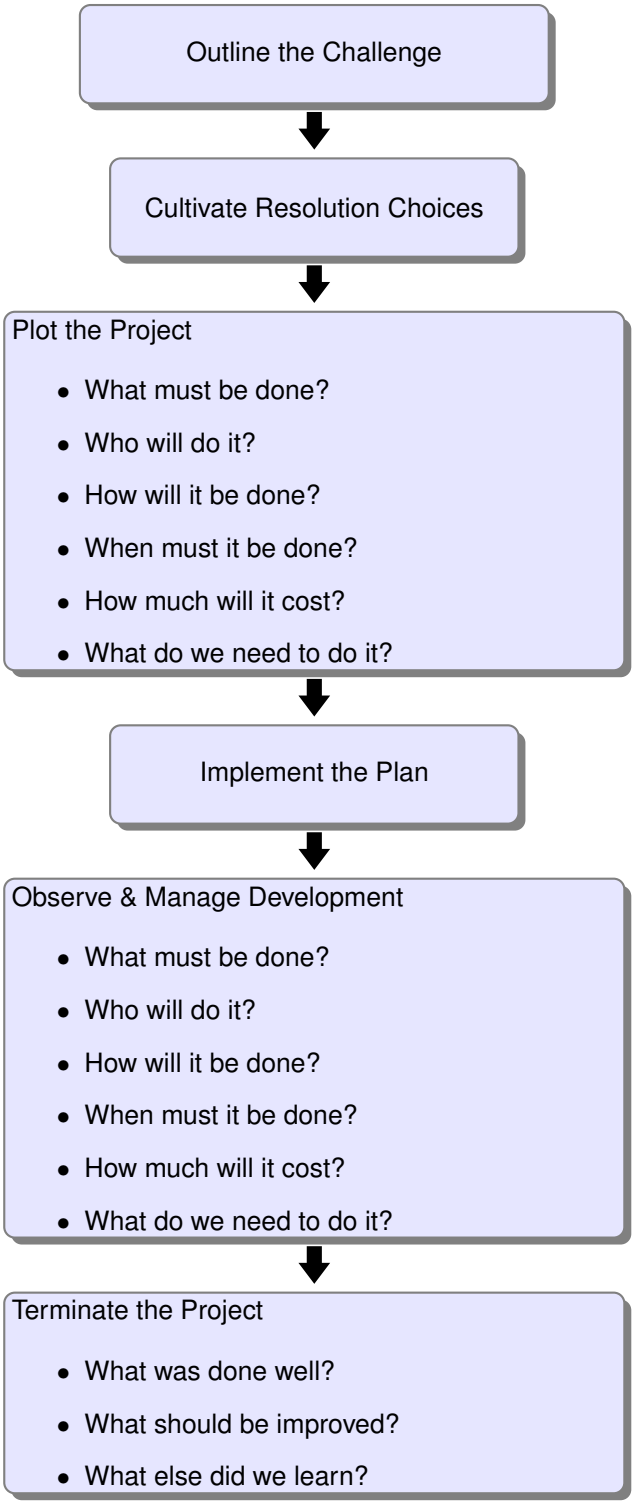


Figure 11: The Project Management Process (Heagney, 2016)

2.6.4 Management of Systems

Systems Engineering

Each industry has its particular techniques, be it programming, mechanics, development, or research. These outlines work fine in the same division. The challenge is if projects stretch out across more than a few areas or departments. It suggests the links between the techniques for these departments. The product manager needs to align its needs with the applications to use in the organisation, marketing, and so on (Weilkiens, 2006).

There have been more than five thousand years of human existence in the world. The ancient Egyptians created their noteworthy pyramids without systems engineering. Systems engineering introduction is in the twentieth century. Since the links are straightforward, engineers can see all the tasks in an organisation as well as the growth opportunities (Weilkiens, 2006).

Engineering Systems Management

As delineated by Figure 12, systems engineering management is achievable by coordinating three significant actions:

- Development staging that controls the planning and sets out starting points that arrange outline aims;
- A process that creates a flow to take care of issues and follows preconditions to move through the plan; and
- Life cycle incorporation that includes clients in the planning throughout the life of the project.

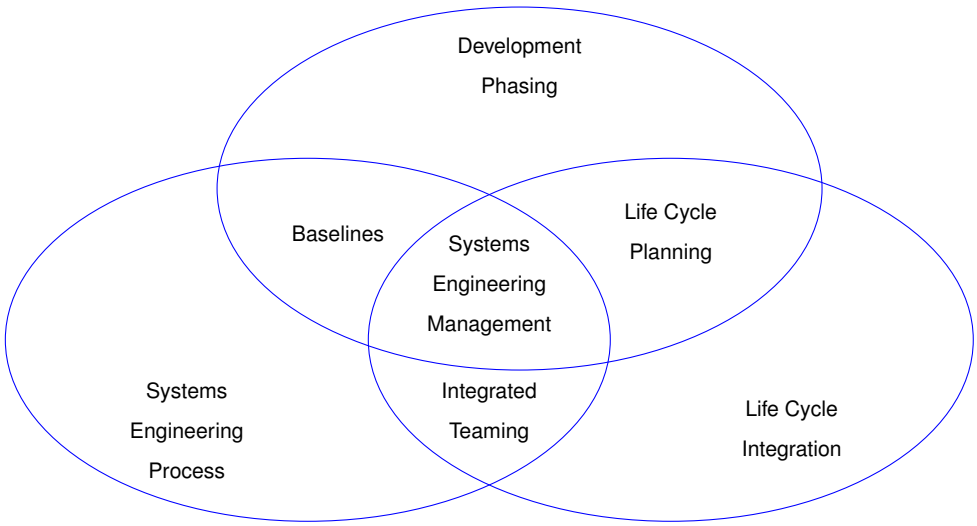


Figure 12: Three Activities of Systems Engineering Management (DoD, 2001)

2.7 Future of Engineering Management

For functions and knowledge domain, managers must work in a multidiscipline domain. Engineering managers need to adapt to constant and quickly-changing needs. A portion of the critical difficulties of the engineering manager follows (Dhillon, 2002):

- **Changing technology.** The change in technology is concerned with the powerful use of real innovation and future technologies. The new technology involves planning, forecasting and benefits.
- **Limited resources.** Managers must face cost compression, asset sharing, restricted access to workforce, also, changing needs. The effect of constrained assets incorporates needs, conflict and planning.
- **Task complexity.** Engineering jobs are more unpredictable and vast than their non-technical partners. To develop an engineering unit, engineering managers need skills in planning, risk management, and people management.
- **Multifunctional team-building.** Engineering undertakings to organise along useful lines are vast. However, building a decent engineering team requires a broad range of management abilities to recognise, present, and coordinate various individuals from support into a single management unit. Team-building has a significant impact on leadership, organising, planning and control.
- **Date-driven schedules.** Meeting due dates is a substantial part of any business, however, in engineering, managers must find trade-off answers for specific issues without abandoning economy, execution, security, and their exhibitions to meet the due dates. In this manner, the effect territories of end-date driven timetables incorporate dangers and are settled on by choices, imagination, strife, and quality. Project management plays a key role in this.
- **Uncertainty and risks.** Variables such as spending, expanding technologies, competition to finish assignments on time, and changing economic markets to engineering managers' challenges. All these affect success and planning.
- **Creativity and innovation.** The successful edge of any engineering firm has creative frontier influencing, for example, quality and economy. The engineering manager's role is to promote and foster the culture of individuals to be inventive and to use their imaginations. The result of this is team-building and better leadership.
- **Limited rewards.** As conventional rewards, for example, increases in compensation, rewards and career promotions turn out to be rare. Engineering managers must make rewards from achievements, promotions, work difficulties, and flexibilities to stay current. Constrained bonuses create turnover, leadership, and inspiration.

Even though engineers need some formal training to pick up abilities, an adjustment in culture needs a change in education. It is sensible to prepare engineering managers by teaching them skills complementing their roles, although it may be hard to teach them.

2.8 Industry 4.0

Industry 4.0 is to be the fourth industry developing from an industrial revolution, with the idea of combining data and communication within a customised factory Cyber-Physical System. The aim of industry 4.0 is to improve manufacturing and production through digital platforms. The human link to production is always in real-time during manufacturing (Zhou *et al.*, 2015).

Engineering managers need to learn about marketing and the latest skill and available management tools. As discussed in Chapter 1, the engineering industry plays a great role in the economics of the country. Economic changes put pressure on industries to adapt to changes, and industrial revolution takes its course (Shamim *et al.*, 2016).

Ideal organisational designs result in a better competitive edge. The Germans lead in using Industry 4.0 to contribute to organisational efficiency by 91%. However, three-quarters of organisations realised the benefit. Trends show the industry will adopt the industry 4.0 concept. With Cyber-Technology penetrating the engineering field, South African business entities may adopt the ideas of industry 4.0 (Matthias, B. and Richard, K. and Robert, M. and Dominik, W, 2016).

The fourth industrial revolution will create a need for engineering managers to work in conjunction with other professionals. Universities may need to review their methods of educating engineers. The methods can be through teaching Industry 4.0 or aligning with Industry 4.0 (Richert *et al.*, 2016).

2.9 Curriculum Offerings at Universities in South Africa

2.9.1 Engineering Management Course

The first launcher of Master's in Engineering Management Degree in South Africa is the University of Pretoria. The programme addresses the management training that is not in the undergraduate programs and the skill set needed for engineering firms (Garg and Rajah, 2012). In general, the four-year Bachelor Degree is the minimum requirement for admission.

2.9.2 Various Institutions in SA Offer Engineering Management Courses

University of Johannesburg

Engineering Management programmes at UJ are divided into four programmes, comprising of two research and two lectured programmes. The choice of study is either full-time or part-time. The programmes cater for mainstream Bachelor Degrees and Bachelor of Technology Degrees. On completion of the qualification, the candidate receives a degree in Master of Engineering (ME) or Master of Philosophy (MPhil) (University of Johannesburg, 2017). To achieve this degree is only possible after completing six coursework modules and a mini-dissertation

Lecturing is in the form of contact sessions and audio. Web-based learning is also available to students for assessments. To complete the programme takes a minimum of 2 years (University of Johannesburg, 2017). The coursework modules are as follows:

- Engineering Management
- Advanced Engineering Economics
- Systems Engineering
- Project Management
- Product Development and Marketing
- Reliability Management

In addition to the coursework, research accounts for 50% of the degree. The research topic must align with the coursework studies (University of Johannesburg, 2017).

Online learning is available on certain subjects on platforms like Webex. Students send assignments to the University online through the Blackboard system. To promote regular course improvements, UJ uses evaluations in the form of surveys and questionnaires. For their dissertation, candidates meet regularly with their supervisors and send documents for review (University of Johannesburg, 2017).

Streaming of lecture sessions is available, slow bandwidth in South Africa is a challenge. Students may ask for copies of the recordings through the UJ Engineering Management faculty office (University of Johannesburg, 2017).

University of Pretoria

As the spearheader of the engineering management programme at postgraduate level in South Africa, the University of Pretoria (UP) aligns to the universal economy because of services and production methods. The degree is graded at Master's level and has a duration of two years. The degree awarded is ME or Master of Science (MS) in Engineering Management (University of Pretoria, 2017).

The course is comprised of research and learning modules as set out below:

- System Engineering and Management
- Production and Operations Management
- Technology Management
- Research Method
- Maintenance Management
- Project Management
- People Management
- Literature Study

University of Cape Town

The University of Cape Town (UCT) has various postgraduate degrees and among them is the Master of Philosophy in Engineering Management. The Master's degree in engineering management comprises of one-third coursework and two-thirds research. The total credits to finish the degree is 180 over a minimum of one year (University of Cape Town, 2017).

Stellenbosch University

Stellenbosch University (SUN) offers a single Master in Engineering Management programme. In support of the candidate's research interest, there are four to five essential modules in this programme. Experience and undergraduate background are key to this degree. The Department of Industrial Engineering is the guardian of engineering management at SUN (Stellenbosch University, 2017).

The modules offered by SUN are as follows:

- Analytics and Synthesis
- Research Methodology
- Technology Management
- Management Fundamentals for Engineers

North-West University

The North-West University (NWU) also offers a Master's degree in Development and Management. The degree is in two-fold: comprehensive research and 44.44% coursework or lectured with 55.56% mini-research. NWU has a remote campus in Pretoria for their post-graduate training. The formulation of the coursework is as follows:

- Project Management
- Maintenance Management
- Corporate Career Skills
- Production Optimisation Management
- Entrepreneurial Career Skills
- System Engineering
- Management of Information
- Operations Management

The choice for coursework selection is five modules. 180 credits must be obtained for the award of the qualification.

2.10 Curriculum Offerings by Members of Universitas 21

Universitas 21 is a network of universities founded in 1997. The objective of Universitas 21 is to open the academic space by promoting communication of various universities within the network. This network comprises of 21 universities around the globe (Universitas 21, 2017).

2.10.1 Australia

University of Melbourne

The University of Melbourne offers a two-stream Master Degree in Engineering Management internationally. The course aims to bridge the gap between engineering skills and managerial skills, which are needed by engineers to perform better as engineering managers. The award of the degree is upon completion of the coursework after one year full-time or two years part-time. The course offerings are Change Management and Project Management, made up of two-course formats. The formats cater for various types of students with different work experience. Students with more than two years' industry experience may elect Master of Business Administration (MBA) subjects, or only Engineering Management subjects (University of Melbourne, 2017).

University of Queensland

The University of Queensland Master of Engineering (Management) is no longer available. The last student intake was in 2011, focusing on the following fields:

- Electrical Engineering
- Engineering Science
- Software Engineering

The new degree is Master of Engineering Science (Management) with 32 units, consisting of 24 units from other engineering fields and eight compulsory units. The term of the degree is two years on a full-time basis (University of Queensland, 2017). The compulsory eight units of modules are:

- Advanced Engineering Practice (2 units)
- Experimental Design (2 units)
- Environmental Performance of Materials (2 units)
- Management Communication (2 units)

University of New South Wales (Australia)

The University of New South Wales (UNSW) offers a Master of Engineering Science (Manufacturing Engineering and Management) degree. The degree includes 16 modules such as:

- Disciplinary knowledge courses
- Advanced disciplinary knowledge courses
- 3 Research courses
- 4 Engineering and technical management electives

The minimum duration to complete is two years (UNSW Australia (the University of New South Wales), 2017).

2.10.2 Canada

University of British Columbia

The University of British Columbia (UBC) offers a one-year full-time Master's degree in Engineering Leadership. The degree concentrates on resource engineering management to improve engineers' managerial skills. The course structure is six technical and six leadership modules (University of British Columbia, 2017).

McGill University

The McGill University (MU) offers a one-year coursework based Master of Manufacturing Management degree. The degree includes a four-month internship programme, promoted by the Faculty of Engineering. The programme is the engineers' choice of study to an MBA (McGill University, 2017).

2.10.3 Chile

The Pontificia Universidad Católica de Chile (PUC) has no engineering management degree at Master's level. Nonetheless, it offers a Master's Degree in Industrial Engineering (Pontificia Universidad Católica de Chile, 2017).

2.10.4 China with Hong Kong (SAR)

Fudan University

Fudan University does not offer engineering management.

The University of Hong Kong

The University of Hong Kong (UHK) offers a Master of Science in Engineering (Industrial Engineering and Logistics Management) degree. The degree comprises of eight compulsory modules and a

dissertation. The duration of the course is one year full-time and two years part-time (University of Hong Kong, 2017).

Shanghai Jiao Tong University

Shanghai Jiao Tong University does not offer engineering management.

2.10.5 India

The University of Delhi (UoD) offers a two-year M.Tech Engineering Management programme. The course is available on a full-time and part-time basis. The course is either only coursework or only a dissertation (University of Delhi, 2017).

2.10.6 Ireland

The University College Dublin (UCD) offers a one-year full-time MEngSc Engineering Management degree. The degree comprises of 90 credits: 75 credits of coursework and 15 credits for a dissertation. The university also offers a two-year Master of Engineering Management degree, which consists of 18 modules of coursework. A real-life project can replace three modules in the second year of this degree (University College Dublin, 2017).

2.10.7 Mexico

Tecnológico de Monterrey

The Master's in Engineering Management degree comprises of 21 subjects at Tecnológico de Monterrey. Completing the course takes up to two-and-a-half years (Tecnológico de Monterrey, 2017).

2.10.8 New Zealand

The University of Auckland (UoA) has an international Master's Degree in Engineering Management that can be completed in one year full-time or extended to four years on a part-time basis. The degree consists of a compulsory research project and coursework (University of Auckland, 2017).

2.10.9 Singapore

The National University of Singapore (NUS) offers a Master of Science (Management of Technology) degree that takes one year full-time or extended to four years on a part-time basis to complete. Modules from other Master's degree are acceptable for credits (National University of Singapore, 2017).

2.10.10 South Africa

Engineering Management Master's programmes at the UJ are divided into four sections, comprising of two research and two lectured programmes. The choice of study is either full-time or part-time. The degree comprises of six coursework modules and a mini-dissertation, or full research. The programme takes a minimum of two years to complete (University of Johannesburg, 2017).

2.10.11 South Korea

Korea University offers a Master of Science (Management Engineering) degree. A compulsory conference paper is a pre-requisite to complete the degree with 21 modules making up the coursework (Korea University, 2017).

2.10.12 Sweden

Lund University

The Lund University (LuUni) offers a one-year full-time Master's degree in Management. The degree is open to candidates interested in management, and eight modules (equating to 60 credits) are required to complete the degree (Lund University, 2017).

2.10.13 The Netherlands

University of Amsterdam

University of Amsterdam does not offer engineering management.

2.10.14 The United Kingdom

University of Birmingham

The University of Birmingham (UoB) offers an Advanced Engineering Management MSc (with Specialist Pathways) degree. The choice of study is either full-time or part-time. The degree comprises of six coursework modules and a dissertation. The setup is 50% research and 50% coursework. The duration of the course is one year full-time or three years part-time (University of Birmingham, 2017).

University of Edinburgh

The University of Edinburgh (UoE) offers an MSc in Management. The degree comprises of nine coursework modules and a dissertation. The duration of the course is two years (University of Edinburgh, 2017).

University of Glasgow

The University of Glasgow (UoG) offers the Masters in Mechanical Engineering & Management. The choice of study is one year full-time. The degree comprises of six coursework modules and a dissertation. The setup is 50% research and 50% coursework (University of Glasgow, 2017).

University of Nottingham

The University of Nottingham (UoN) offers an MSc Manufacturing Engineering and Management degree. The degree takes one year of full-time study to complete. It comprises of eleven coursework modules and a dissertation. The setup is 60 credits research and 120 credits coursework (University of Nottingham, 2017).

2.10.15 The United States of America

University of Maryland

The university of Maryland does not offer engineering management.

University of Connecticut

University of Connecticut does not offer engineering management at Master's level. The offer is an undergraduate Bachelor's degree in Management and Engineering for Manufacturing.

The Ohio State University

The Ohio State University (OSU) offers a Master of Global Engineering Leadership degree online with a minimum duration of one year (The Ohio State University, 2017). Contact classes are available on an hourly basis.

2.11 American Society for Engineering Management

The University of Missouri-Rolla (UMR) has been the cornerstone of the ASEM since 1979. The ASEM promotes engineering management worldwide. The society fosters greater levels of the professional behaviour of members (American Society for Engineering Management, 2013). Engineering managers can get further training through the American Society for Engineering Management. Candidates will receive a certificate of after successfully passing the ASEM examination (ASEM, 2013).

2.11.1 American Society for Engineering Management Affiliation

Professional

The home for technical managers and a platform to find professional industry hints throughout the network. People qualified as engineering managers are encouraged to be part of the growing profession, join the association (ASEM, 2013).

Student

This category creates an opportunity for students to start thinking about management while still studying. It allows students to stay abreast with what is happening in engineering management and meeting fellow students to build contacts (ASEM, 2013).

International Membership

Other countries wishing to join the association are welcome to do so. The intent to form local branches is subject to evaluation by ASEM's headquarters. The local branches are according to the locations, and fees are according to the economic standing of the country y (ASEM, 2013).

Academic

The Universities may join the ASEM as academic partners. The university subscription fee is steady and allows a pool of university students access to ASEM's (ASEM, 2013).

Corporate

The constant communication with industry partners preserves close relations. The links bring about best practice in engineering management (ASEM, 2013).

2.11.2 Celebration of Affiliated Universities

ASEM celebrates the following university for the regular and uninterrupted association:

- Continental University, Peru
- London South Bank University
- Portland State University
- Purdue University
- Robert Morris University

- Royal Military Academy
- St. Cloud State University
- Western Michigan University
- University of Colorado, Boulder
- Gonzaga University

The full list of affiliated Universities is as per Appendix B for the United States of America (USA) and Appendix C for the for other countries.

2.12 Conclusion

The need to address engineering management is driving many universities to develop engineering management programmes. Engineering management courses are acceptable at Master's degree level. Recent graduates are most likely not assigned to any engineering management projects for several years after graduation.

Engineering management definition is in many ways. The path chosen here is to examine a typical engineers career and look at the knowledge and skills needed to be successful in this career. Engineering management can be the knowledge and expertise necessary to be successful when an engineer reaches the supervisor or manager level. These skills are mainly soft skills rather than the technical skills required in pure engineering. Addressing the question "What is engineering management?" will cause more engineers and engineering managers to engage in a discussion about not only the definition but also the importance of engineering management. It is a necessary building block to a successful engineering career.

Chapter 3

Research Design and Methodology

In this chapter, the research will follow a methodical procedure to find logical learnings about particular issues experienced in everyday life and expert practice of engineering managers. Thus it is a vital method of discovering answers to inquiries on engineering management programmes and skills needed by engineering managers through the courses. When a researcher embarks on a research study to find out answers to a question, a motivation supporting a method needs to be clear and elaborate on a construction of how to report the analysed data.

3.1 Research Design

The research will follow the use of desktop study known as the secondary research. The method is to gather data and correct information to find out the status of the population under study. The desktop study compares the engineering management curriculum at universities around the world. The collection of data is through electronic sources, for example, the Internet or online search (Hair *et al.*, 2015).

3.1.1 Strengths of Secondary Research

- It is cost-effective to conduct desktop research
- Data available is in real-time
- There is a likelihood of new findings towards the research
- The researcher speaks to no one during the search

3.1.2 Weaknesses of Secondary Research

- Information may be too old.
- The accuracy of data is not clear.
- There may be challenges in accessing data.
- The data may not be relevant to the purpose.

3.2 Research Method

The method of preference is the quantitative and descriptive method. The method selection is by answering the following questions:

- What are the current global universities offering engineering management and in what formats?
- What are the specific skills and courses defined by international best practice, unique to engineering managers?
- What are the trends of engineering management offerings at universities in SA and globally?
- What makes UJ relevant in offering an engineering management degree?

3.3 Quantitative

Analysis of data is by means of quantitative studies. Multiple methods are useful if they provide better opportunities and where they allow the researcher to evaluate the research findings better to answer research questions (Saunders *et al.*, 2009). See Table 2

Table 2: Distinctions Between Quantitative and Qualitative Data (Saunders *et al.*, 2009)

Quantitative data	**Qualitative data**
Based on meanings gained from numbers.	Based on meanings expressed through words.
The collection brings about numerical and consistent data.	The collection brings about varying data needing classification.
Analysis conducted by using drawings and numbers.	Analysis conducted by using theory.

The research is interested in numbers and instances of the degree offered by UJ, including the definition of skills for engineering managers provided by these courses.

3.4 Descriptive

The descriptive research shows a description of a group of people or elements. It is interested in the current state of items under study. The study preferred this because of the following traits (Cooper and Schindler, 2013):

- The researcher decides the criteria.
- The researcher seeks to find out what is happening.
- It involves a sound population trend examination.

The research follows the guide from the University of Johannesburg, with the selected units to find out the knowledge area of engineering management in South Africa and globally. The guide will help to describe the status and future of engineering management. The literature in Chapter 2 also highlights the knowledge area of engineering management. The following categories are used to form a matrix to follow in the study: The following categories are used to form a matrix to follow in the study:

1. University
2. Master's Course
3. Doctor of Philosophy (PhD) Course
4. Bachelor Course
5. Full-Time
6. Part-Time
7. Online
8. Campus
9. Dissertation Option
10. Project Management
11. System Engineering
12. Engineering Economics
13. Engineering Management
14. Product Development and Marketing
15. Reliability Engineering

3.5 Target Population

The target population for the research was the universities offering engineering management. The universities are mainly in the USA. The study will evaluate the Master's Degrees in engineering management at universities in South Africa, universities affiliated with ASEM and Universitas 21 members. The exclusion and inclusion condition used is the common affiliation to UJ. The universities selected are accessible by sharing a similar affiliation with UJ. The excluded universities will be not in the best position to provide necessary information, and the population is unstable.

3.6 Sampling Procedure

Sampling is the procedure of behavioural research. No research can be acceptable without sampling. Studying the population in total is an unachievable exercise. Sampling aims to find facts based on the research. The sampling method is a formation to build the likelihood of choosing people or items that will show the biggest population (Singh, 2006).

3.6.1 Sampling Techniques

According to (Saunders *et al.*, 2009), there are two types of sampling:

- Probability
- Non-probability

Probability sampling is the technique that offers every element a chance to be part of the study. In non-probability, only the sampled population forms part of the study (Cooper and Schindler, 2013).

3.6.2 Non-Probability Sampling

In this method, the researcher decides the population for the study. In this method, the researcher decides the population for the study. For this study, the non-probability is the preference because not all the units of the population form part of the study (DePoy and Gitlin, 2013). The non- probability technique has subsets including quota sampling, snowball sampling, convenience sampling, purposive sampling, and self-selection sampling (Saunders *et al.*, 2009).

3.6.3 Sample

The pre-determined population samples of universities form part of the study. The following universities are accessible Universitas 21, ASEM Program List, universities in South Africa. The benchmark test is for a sound pool of the population under study is used (Singh, 2006).

3.6.4 Quota Sampling

Quota sampling has an element of judgement sampling and probability sampling. The knowledge of population is in this sampling method. Hence, the researcher selects the population before the study begins (Singh, 2006).

3.6.5 Sample size

South Africa

A detailed analysis of South African programmes relative to global with a specific focus on the programme offered at UJ.

Universitas 21

UJ is a member of Universitas 21. Refer to Appendix A.

American Society of Engineering Management

The University of Johannesburg affiliates with ASEM under the non-American portal. The following universities listed in Appendix B are part of the study. The final population of the research study is the affiliates of ASEM, one of the leading bodies in engineering management. Refer to Appendix C.

The total number of the universities illustration is in Figure 13.

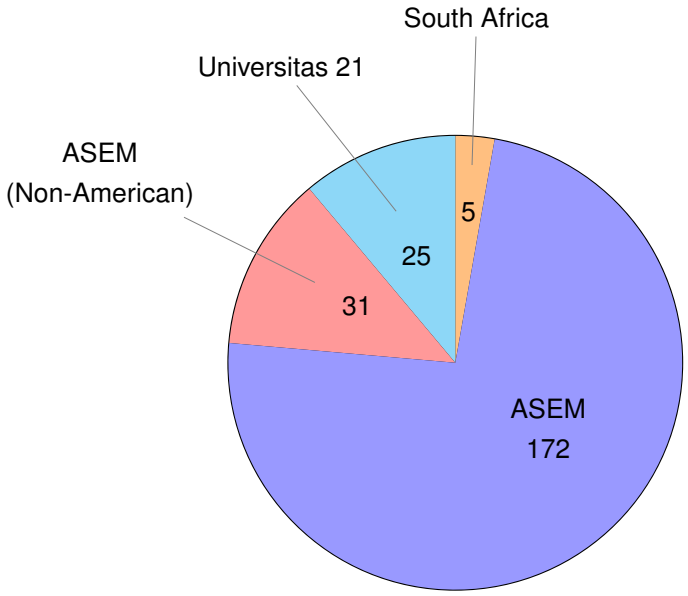


Figure 13: Population Sample Size

Universities to Justify the Population

The desktop study was completed to survey how many universities offer engineering management courses at Masters Level. According to Keystone Academic Solution (2017), 104 universities worldwide offer a Master's in Engineering Management. Refer to Appendix D. The number from QS Quacquarelli Symonds Limited (2017) is 142. See Appendix E. Together, these numbers equal 242 universities.

A python script was written to extract information from the ASEM web page. The nature of the python script is as illustrated in Figure 15. This script extracts all the universities listed in ASEM website under EM-Program-List.

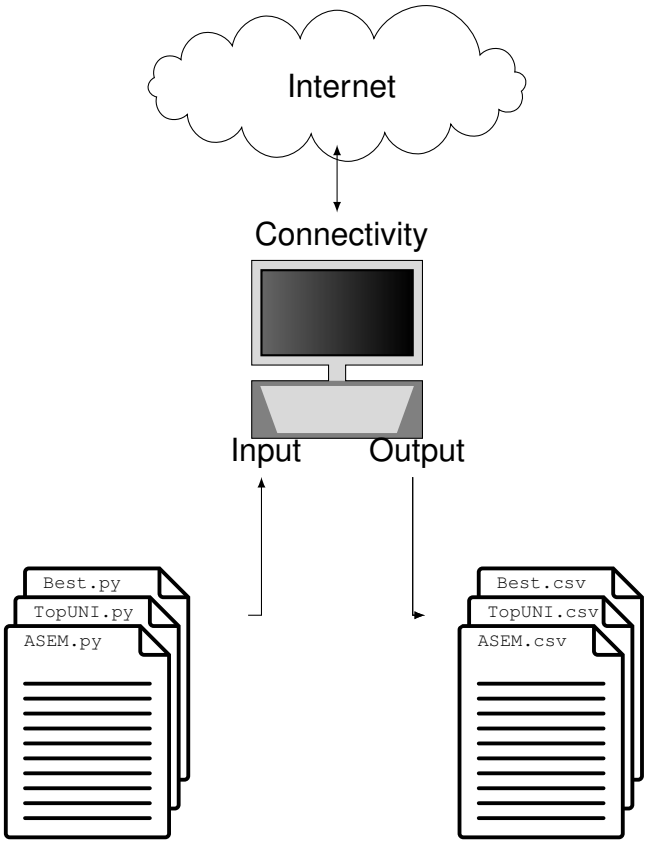


Figure 14: Python Scripting Activity

ASEM Website

Open ASEM.py Save

ASEM.py

```
from bs4 import BeautifulSoup
import requests
page = requests.get("https://www.asem.org/EM-Program-List")
soup = BeautifulSoup(page.content)
links = soup.findAll("strong")
for link in links:
        print link.text
```

Figure 15: Python Screenshot

The python script is then called up in the Ubuntu command terminal to start extracting data from the website, and a sample of the results is in Figure 16. This data is the same data used to formulate a sample to be studied.

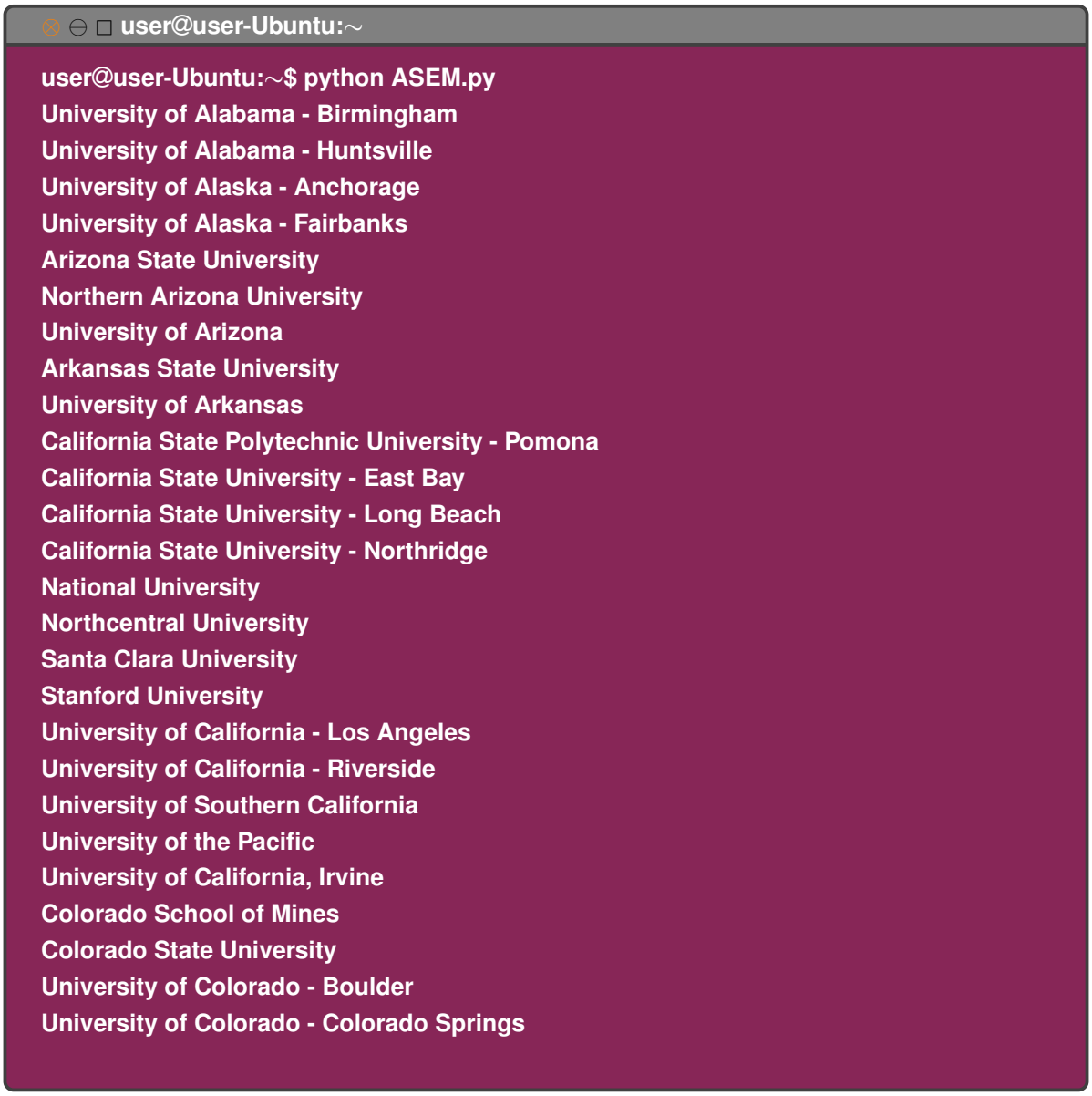


Figure 16: Ubuntu Desktop Output

The same procedure is used to extract the information from the sampled websites from more than 35 universities.

Top Universities Website

A python script was written to extract information from the Top Universities web page. The nature of the python script is as illustrated in Figure 17. This script extracted all the universities listed in the Top Universities website under Post Graduate Engineering Management.

Open TopUniversities.py Save

TopUniversities.py

```
from lxml import html
import requests
import csv
page = requests.get('https://www.topuniversities.com/'
                    'universities/level/postgrad/'
                    'subject/engineering-management/'
                    'region/africa/region/asia/'
                    'region/europe/region/latin-america/'
                    'region/north-america/region/oceania')
tree = html.fromstring(page.content)
TopUniversity = tree.xpath('//*[@id="universities-search"]/'
                           'li/a/h2/text()')

print TopUniversity

with open('TopUniversity.csv', 'a') as csv_file:
    writer = csv.writer(csv_file)
    writer.writerow([TopUniversity])
```

Figure 17: Python Screen Top Universities

The python script was then called up in the Ubuntu command terminal to start extracting data from the website, and a sample of results is illustrated in Figure 18. This data is the same data used to formulate a sample to be studied.

user@user-Ubuntu:-

```
user@user-Ubuntu:-$ python TopUniversities.py
[ 'Peter the Great Saint-Petersbu ...', 'The University of Queensland', 'McMaster
University', 'Chalmers University of Technology', 'The Hong Kong University of Sc ...',
'Politecnico di Torino', 'Auckland University of Technol ...', 'The University of Arizona',
'Aalborg University', 'Cardiff University', 'HK PolyU School of Design', 'University of
Johannesburg ', 'Lund University', 'University of Lincoln', 'Plekhanov Russian University
o ...' ]
```

Figure 18: Python Screen Output Top Universities

Best Master's Studies Website

A python script was written to extract information from the Top Universities web page. The nature of the python script is in Figure 19. This script extracted all the universities listed in the Best Masters website under Post Graduate Engineering Management.

Open BestMasters.py Save

BestMasters.py

```
import csv
import urllib2
from BeautifulSoup import *

courses_list = []
courses_list.append(("University","Degree"))
for i in range(141):
    url = "https://www.masterstudies.com/search/?
    q=Engineering+Management&filter=program&
    page={0}".format(i)
    r = urllib2.urlopen(url).read()
    soup = BeautifulSoup(r)

    university = soup.findAll('h5', {"class": "listing_provider"})
    degree = soup.findAll('h4', {"class": "listing-title"})

    for uni, deg in zip(university, degree):
        courses_list.append((uni.text,deg.text))
        print ((uni.text.encode("utf-8").strip(),deg.text.strip))
with open ('BestMasters.csv','w') as file:
    writer=csv.writer(file)
    for row in courses_list:
        writer.writerow([s.encode("utf-8") for s in row])
```

Figure 19: Python Screen Best Master's

The python script was then called up in the Ubuntu command terminal to start extracting data from the website, and a sample of results is in Figure 20. This data is the same data used to formulate a sample to be studied.

```
user@user-Ubuntu:-
user@user-Ubuntu:-$ python BestMasters.py
('United Arab Emirates University, College of Engineering', u'Master of Engineering Management')
('Jacobs University', u'Master of Engineering Management')
('The George Washington University - School of Engineering & Applied Science', u'Master of Engineering Management')
('HECTOR School of Engineering and Management', u'Master of Engineering Management')
('HECTOR School of Engineering and Management', u'Master of Engineering Management')
('University of Strathclyde: Faculty of Engineering', u'Master of Engineering Management')
('HECTOR School of Engineering and Management', u'Master of Engineering Management')
('University Of Bergamo', u'Master of Engineering Management')
('Politecnico di Milano', u'Master of Engineering Management')
('Zaragoza Logistics Center', u'Master of Engineering Management')
('United Arab Emirates University, College of Engineering', u'MSc in Supply Chain Engineering and Management')
('Jacobs University', u'MSc in Supply Chain Engineering and Management')
('The George Washington University - School of Engineering & Applied Science', u'MSc in Supply Chain Engineering and Management')
('HECTOR School of Engineering and Management', u'MSc in Supply Chain Engineering and Management')
```

Figure 20: Python Screen Best Master's Studies

3.6.6 Sampling Rationale

The sample universities all have a relationship with UJ by affiliations or geographical location. The selection of the sample was on purpose to provide a reference for the study to be conducted. Also, Saunders *et al.* (2009), confirms that information of the sample group is known, and the subset criteria are fitting as the study is carried out per university.

In addition to the rational, the process of justifying the target population follows the illustration in Figure 21 for benchmarking.

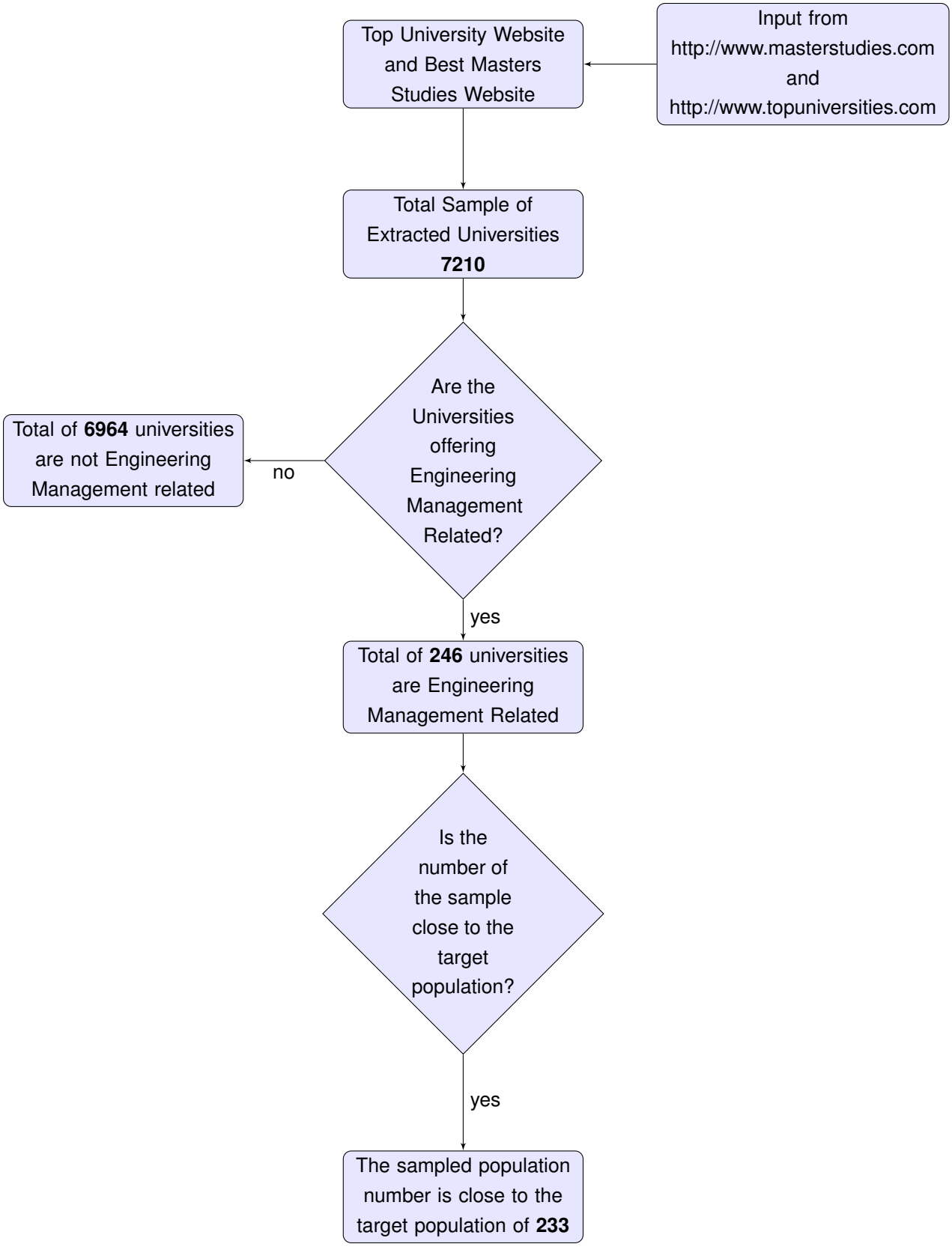


Figure 21: Process of Benchmarking

3.7 Data Collection

Collecting data is common. It forces the researcher to offer new value based on strategic consulting principles (Cooper and Schindler, 2013).

3.7.1 The Instrumentation

As well as Python Script, this research applied a Microsoft Excel spreadsheet as a tool to extract data from universities websites (Microsoft, 2017). The tool used XPath script written to facilitate the extraction of data. See Appendix F, Appendix G and Appendix H. The manual method of extraction is in use for the universities with fewer numbers, i.e. the South African universities, the ASEM (Non-American) affiliated universities and members of Universitas 21.

3.8 Reliability and Instrumentation

Reliability is the degree to which information-gathering methods or examination approaches yield steady discoveries (Saunders *et al.*, 2009). Reliability and research tools are alike. If an examination is steady, stable and exact, it is dependable (Kumar, 2010).

To ensure the information collected during the research was reliable, the researcher script for extracting data is in such a way that if there were a change in the web page, extraction of data would result in errors or wrong data.

3.9 Validity of the Instrument

About the merits of the instrument, the researcher presented a draft copy of the extraction tool to the supervisor. It was agreed to explore the use of the tool to extract data for the analysis. The tool design brings about the connection between study subsets.

3.10 Data Analysis and Interpretation

Data is analysed by means of quantitative studies. Multiple methods are useful if they provide better opportunities and where they allow the researcher to better evaluate the extent to which the research findings can be trusted (Saunders *et al.*, 2009). The information is then transferred to the main Microsoft Excel spreadsheet and sorted in accordance with the quota sample per sheet and the descriptive items of data for better analysis.

3.11 Research Limitation

The research had the following limitations that could cause the information to be incorrect:

- On the target population, not all universities published the full information.

- Some of the universities were silent on certain subsets of the criteria.
- Some universities' websites did not exist.

3.12 Conclusion

A proper plan has to be in place, such as the use of soft applications like Python as part of tools of collecting data to complete the research. Data management discussion is in this chapter, and the next will explore the collected data for analysis and interpret results.

Chapter 4

Research Results and Analysis

The preparation provided by engineering universities is enough for engineers to begin their careers. However, with the change in employment trends, engineers need to be advanced in their skills, especially when they hold positions in management. Universities are a primary source of training, while experience is a secondary source. The success of the engineering management relies on skills and knowledge, while the new ways of delivering these skills are starting to take off. This chapter discusses the information collected using the method in Chapter 3.

4.1 Study Modes

Universities are mindful when developing courses to offer. A couple of items are considered, for example, a target population, industry demands and changes in technology. For this research, the following study modes are by these definitions (Stevenson, 2010):

- **Full-Time:** This is the study mode requiring a regular attendance at the university. Full-time is offered in a similar way to the undergraduate courses.
- **Part-Time:** This is the study mode suitable for the candidates with a day job. It offers the flexibility of attending evening classes or studying by correspondence.
- **Online:** This is the study mode of obtaining a degree off-campus. This study mode is suitable for those who desire to acquire international degrees. It is also known as distance learning which later developed to the Massive Open Online Course (MOOC).

4.2 South Africa

4.2.1 Degrees

Only five universities are offering engineering management or an equivalent at Master's level at the time data extraction. The universities have a strong history and an existence of more than 50 years in South Africa. Other universities merged and, as a result, forming one university. One such university is the University of Johannesburg.

Table 3: Engineering Management: Degrees Offered in South Africa

University	**Master's Course**	**PhD Course**	**Bachelor's Course**
University of Johannesburg	ME/MPhil: Engineering Management	DEng/DPhil: Engineering Management	
University of Pretoria	ME/MS: Engineering Management	Doctor of Philosophy (DPhil): Engineering Management	
University of Cape Town	MPhil: Engineering Management	DPhil: Engineering Management	
Stellenbosch University	ME: Engineering Management		
North-West University	ME: Development & Management	DPhil: Development & Management	
5	**5**	**4**	**0**

In the South African analysis, the University of Johannesburg is the guide representing all universities in the study as stipulated in Chapter 3. The information in Table 3 shows only a few universities, totalling 5. In some studies, this number is insignificant for research. The Master's Degree is at 100% and PhD at 80%. Refer to Figure 22.

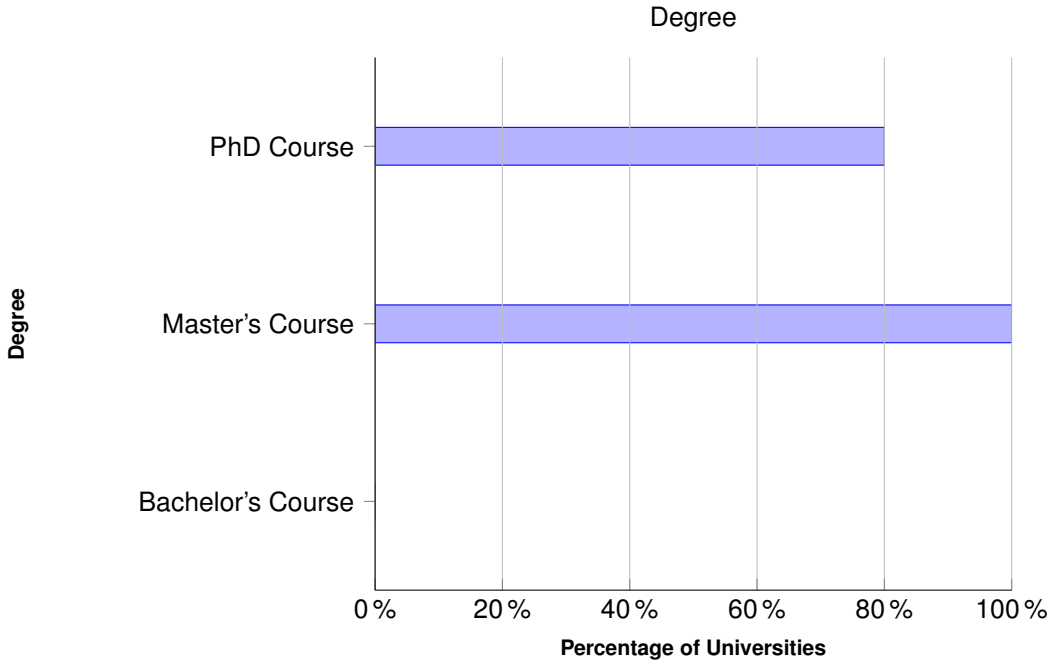


Figure 22: South African Degrees

4.2.2 Delivery Methods

The delivery method alignment with global practice:

Table 4: Engineering Management: Delivery with Dissertations South Africa

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
University of Johannesburg	Yes	Yes	Yes	Yes	Yes
University of Pretoria	No	Yes	Yes	Yes	Yes
University of Cape Town	Yes	Yes	No	Yes	Yes
Stellenbosch University	Yes	Yes	Yes	Yes	Yes
North-West University	Yes	Yes	No	Yes	Yes
5	**4**	**5**	**3**	**5**	**5**

The data in Table 4 reveals a number of the methods of delivery by universities in South Africa. This test signifies that most universities in South Africa are on the same footing on offerings of Master's Degree, the dissertation option is available in all universities showing 100% delivery method. The online method is also gaining momentum at 60%. Part-Time and Full-time is still a preferred method of delivery at 100% and 80% respectively. All universities can deliver at Campus the 100% declares that see Figure 4.

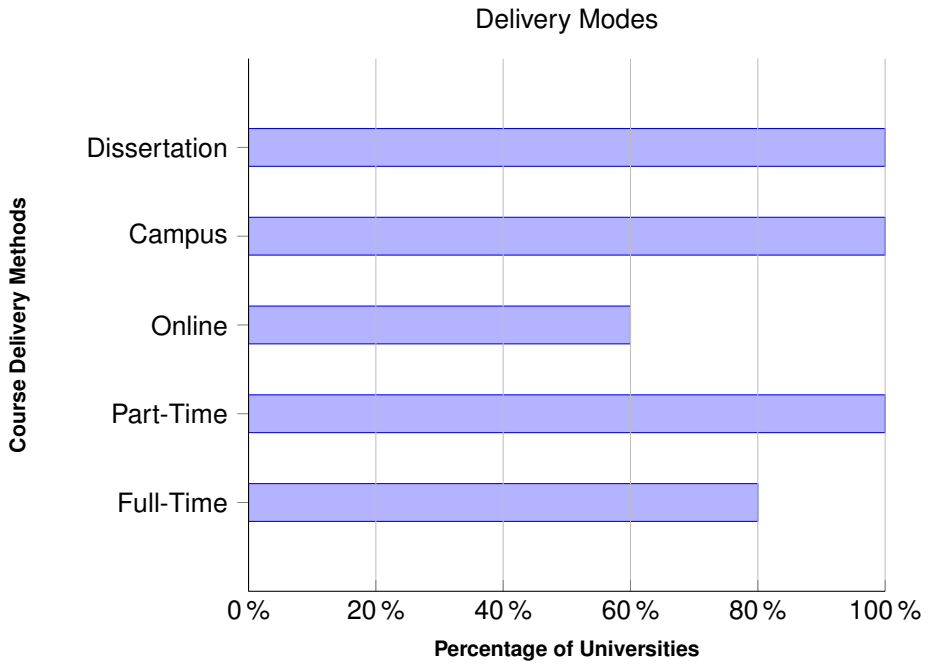


Figure 23: South African Delivery Method against Universities

4.2.3 Subjects

Some Master's degrees have coursework options this may be in different forms and methods as stipulated in Table 4.

Table 5: Subjects by South African Universities

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
University of Johannesburg	Yes	Yes	Yes	Yes	Yes	Yes
University of Pretoria	Yes	Yes	Yes	Yes	Yes	Yes
University of Cape Town	Yes	Yes	No	Yes	No	No
Stellenbosch University	No	No	Yes	Yes	No	No
North-West University	Yes	Yes	Yes	No	No	Yes
5	**4**	**4**	**4**	**4**	**2**	**3**

The following subjects show prominence at 80% (see Figure 24):

- Project Management
- System Engineering
- Engineering Economics
- Engineering Management

The remaining subjects are Product Development and Marketing (40%) and Reliability Engineering (60%).

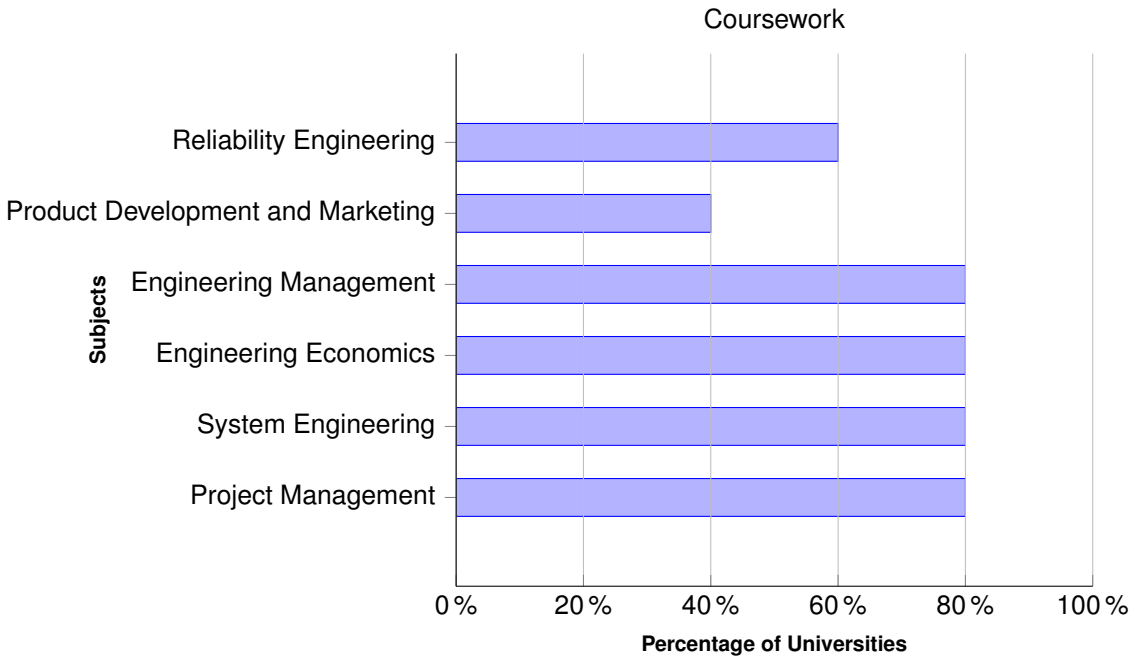


Figure 24: South African Subjects against Universities

4.3 Universitas 21 Members

4.3.1 Degrees

The University of Johannesburg is a member of Universitas 21. This group of universities contributes to academia to determine what the latest trends are and to promote best practices in research.

Table 6: Degrees Offered by Universitas 21 (Summary of Appendix I)

University	Master's Course	PhD Course	Bachelor's Course
25	21	2	2

Master's degrees in this category lead by 84%, with PhD at 8% and Bachelor's 8%. A Master's is a popular degree according to the results. This difference is great, as shown in Figure 25.

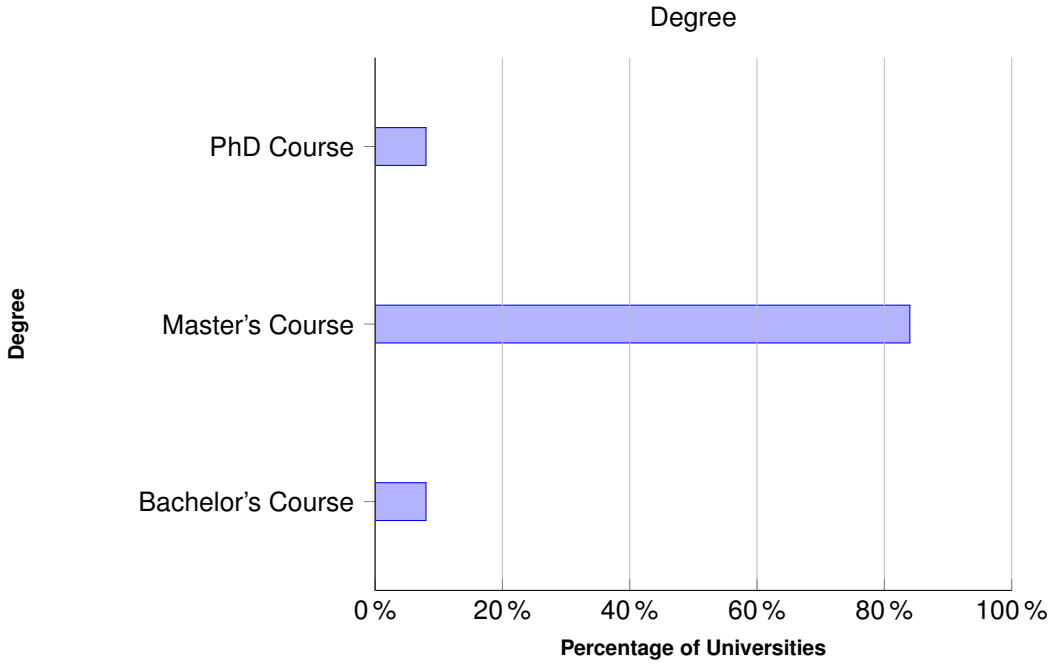


Figure 25: Universitas 21 Degrees

4.3.2 Delivery Methods

Table 7: Universitas 21 Delivery Methods with Dissertations (Summary of Appendix J)

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
25	11	11	4	13	9

The results systematically declare that full-time offerings are at 44%, part-time at 16%, online 16%, and dissertation at 16%. Campus attendance leads the subset with 52% in the interpretation of results from Figure 26.

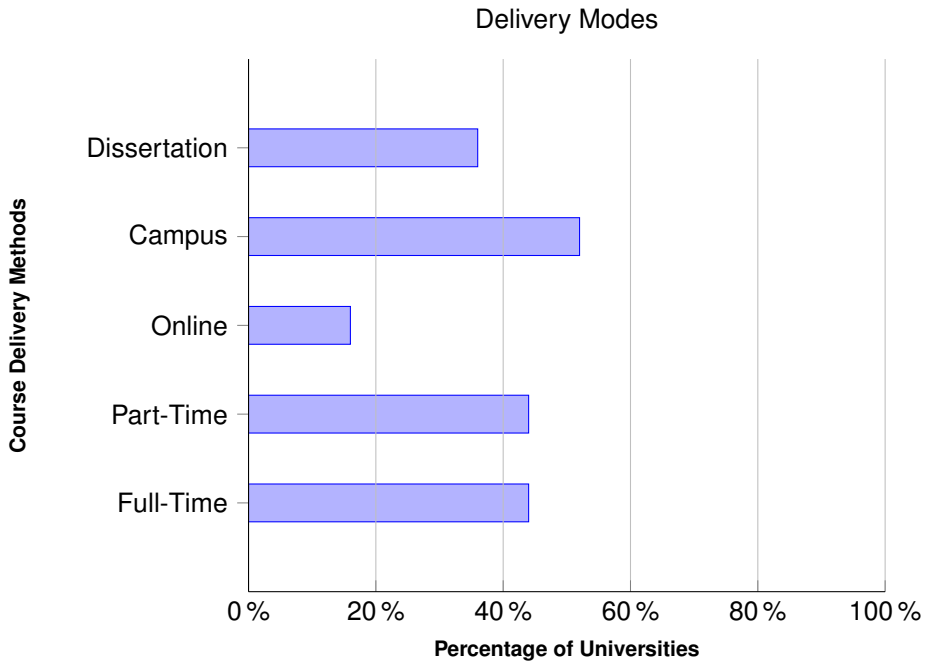


Figure 26: Universitas 21 Members Delivery Method against Universities

4.3.3 Subjects

Some of the universities offer coursework as well, aligned with the University of Johannesburg's curriculum.

Table 8: Subjects by Universitas 21 (Summary of Appendix K)

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
Total 25	**21**	**16**	**18**	**23**	**13**	**11**

Engineering management leads this category. The results of the U21 programme list is as follows (see Figure 27):

- Project Management 88%
- System Engineering 64%
- Engineering Economics 72%
- Engineering Management 92%
- Product Development and Marketing 52%
- Reliability Engineering 44%

On average, most of the universities offer the same or equivalent modules for engineering management in line with the University of Johannesburg, and engineering management is leading other modules. Refer to Figure 27.

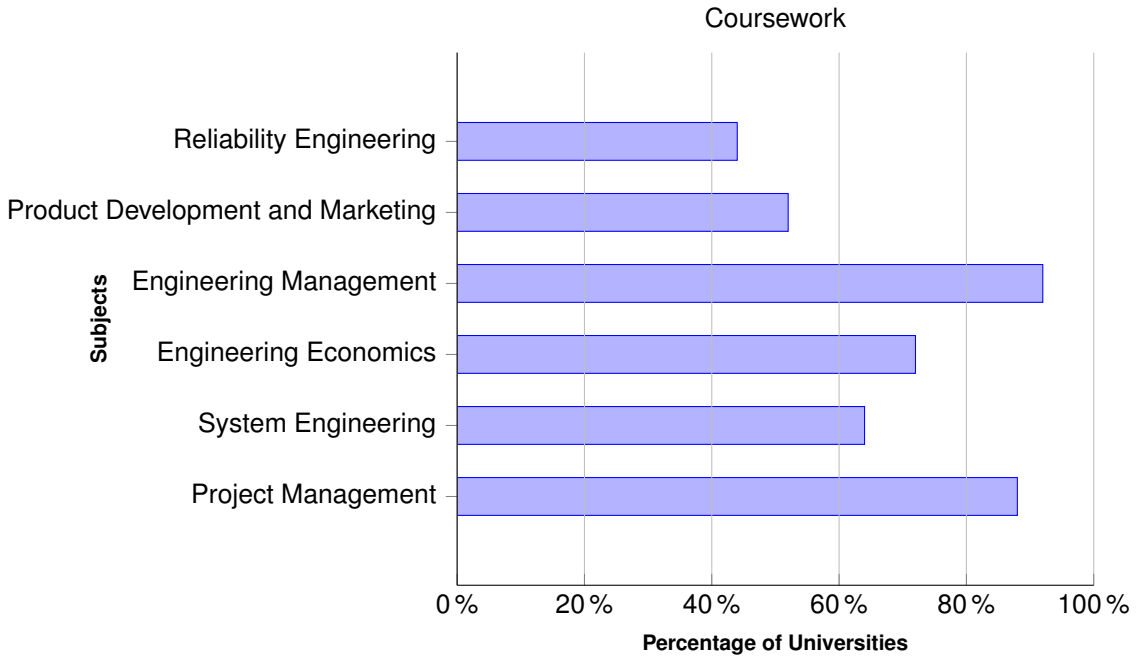


Figure 27: Universitas 21 Subjects against Universities

It is apparent from the results that there exists a strong alignment of the courses offered by the University of Johannesburg with similar institutions in the Universitas 21 group.

4.4 American Society of Engineering Management: Non-American

The universities in this category are affiliates of ASEM but are not in the USA, the University of Johannesburg is the baseline of the study. In determining whether a university offers a Master's degree in engineering management, the population is extracted from the comprehensive ASEM listing on the ASEM website. The Python tool and Microsoft Excel filters out universities by location, separating the American and other institutions. The key reason for this is that the American universities data is delivered independently, which means it does not provide a South African perspective.

4.4.1 Degrees

On analysing the degrees in this category, out of thirty-one universities, nine did not provide any data on degrees offered.

Table 9: Degrees Offered by ASEM (Non-American) (Summary of Appendix L)

University	Master's Course	PhD Course	Bachelor's Course
31	**22**	**4**	**0**

The available results show that Masters Course is 71% and PhD is 13%. These numbers are a clear indication that most universities affiliated with ASEM offer engineering management at Masters Level as shown in Figure 28.

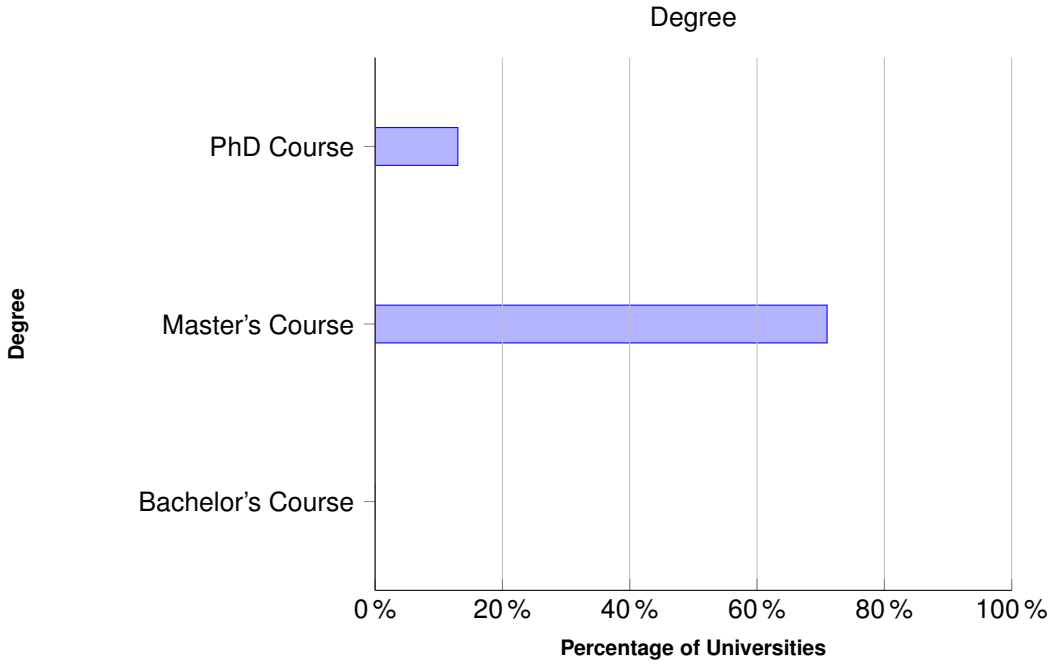


Figure 28: ASEM (Non-American) Degrees

4.4.2 Delivery Methods

The delivery method alignment to UJ with Non-American countries based on the twenty-nine universities with data.

Table 10: Delivery with Dissertations ASEM (Non-American) (Summary of Appendix M)

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
31	7	3	1	4	14

The results define the dissertation as the preferred method of delivery at 45%. The remainder of the delivery methods is below 25%. The results reveal that other delivery methods, especially online delivery at 3%, have not featured. Part-time and on-campus studies are still available, with full-time at 23%. Refer to Figure 29.

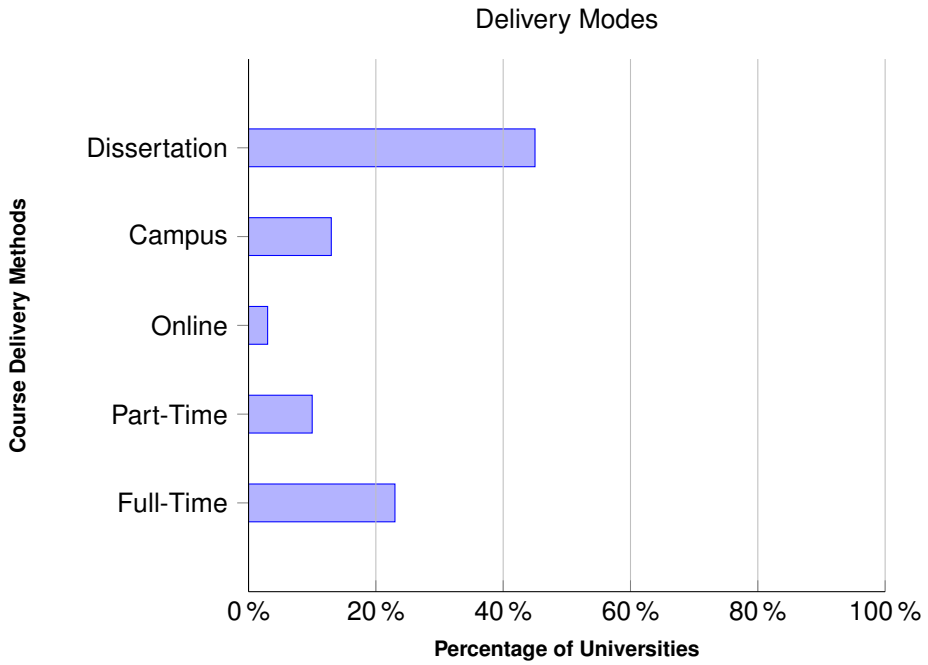


Figure 29: ASEM Members (Non-American) Delivery Method against Universities

4.4.3 Subjects

The coursework is as per the UJ guide with the equivalents; not all countries follow the same course.

Table 11: Subjects by (Non-American) ASEM Listed Universities (Summary of Appendix N)

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
Total 31	**17**	**17**	**11**	**18**	**15**	**15**

The Engineering Management course leads in this category. The results of ASEM (Non-American) programme list is as follows in Figure 30:

- Project Management 55%
- System Engineering 55%
- Engineering Economics 35%
- Engineering Management 58%
- Product Development and Marketing 48%
- Reliability Engineering 48%

The analysis of the courses offered indicates the Engineering Management module has the strongest alignment followed by project management and systems engineering. The other course comparative to

the University of Johannesburg is less than 50% with Engineering Economics with the lowest alignment at 35% see Figure 30. On average approximately, 50% of the universities offer the same or equivalent modules for Engineering Management in line with the University of Johannesburg.

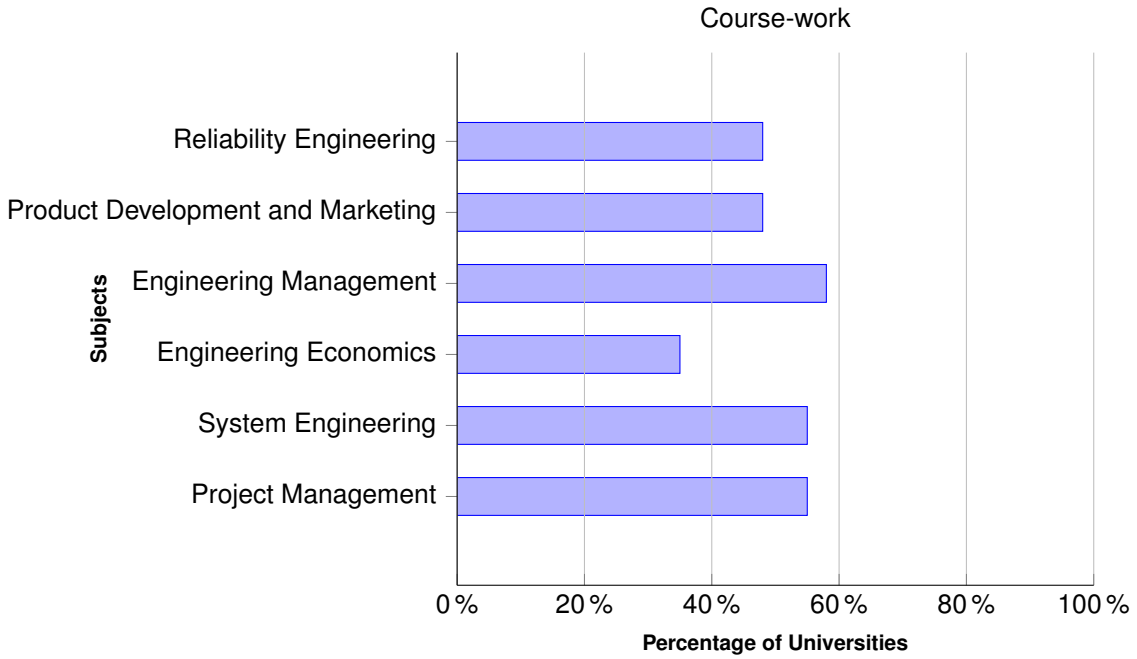


Figure 30: ASEM (Non-American) Subjects against Universities

4.5 American Society of Engineering Management

4.5.1 Degrees

The universities are offering Engineering Management or equivalent at Master's Level.

Table 12: Degrees Offered by ASEM (Summary of Appendix O)

University	Master's Course	PhD Course	Bachelor's Course
172	151	15	47

Concerning UJ, the universities in this category offer Engineering Management at Master's, PhD and Bachelor's level. A total of 172 universities reviews and the results appear in Table 12. The numbers are significant in this category because the ASEM stronghold is in the USA and these universities are in the USA. The Master's degree is leads with 88% followed by Bachelors with 27% and then with PhD 9%. See Figure 31.

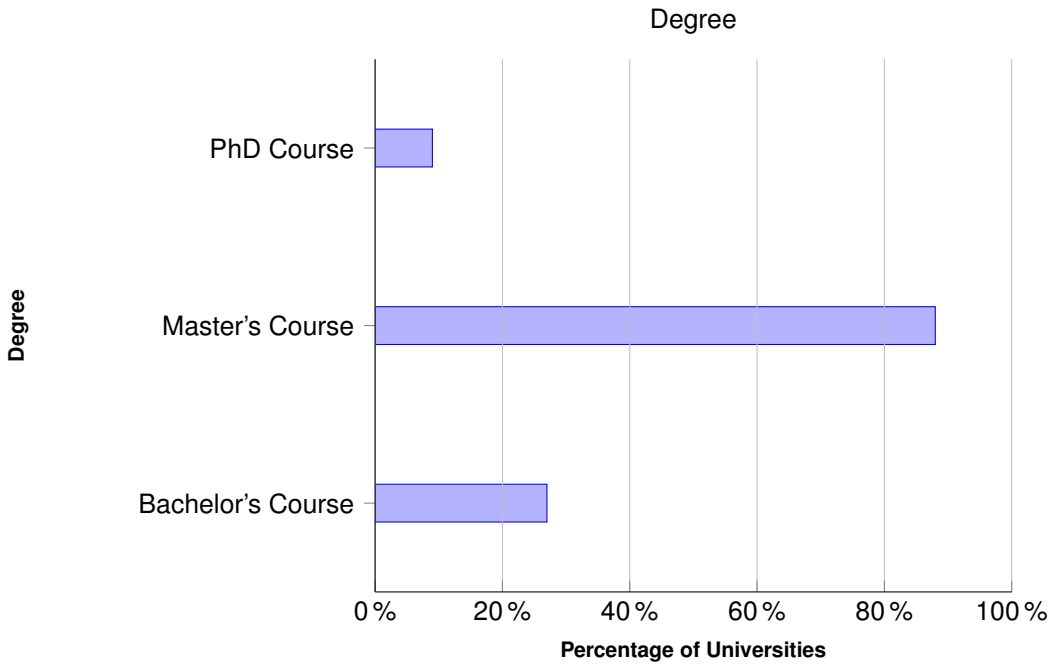


Figure 31: ASEM Degrees

4.5.2 Delivery Methods

The delivery method relative is to UJ.

Table 13: Delivery Methods with Dissertations ASEM (Summary of Appendix P)

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
172	**43**	**71**	**77**	**92**	**77**

The results of delivery show that the campus methods are still prominent in the USA at 53%, just over half of the universities, with the remainder is 25% full-time, 41% part-time, 45% online, and 45% dissertation. The distribution is around 45% for dissertation and online. The results reveal that these may consume half of the full-time. See Figure 32 for clarification.

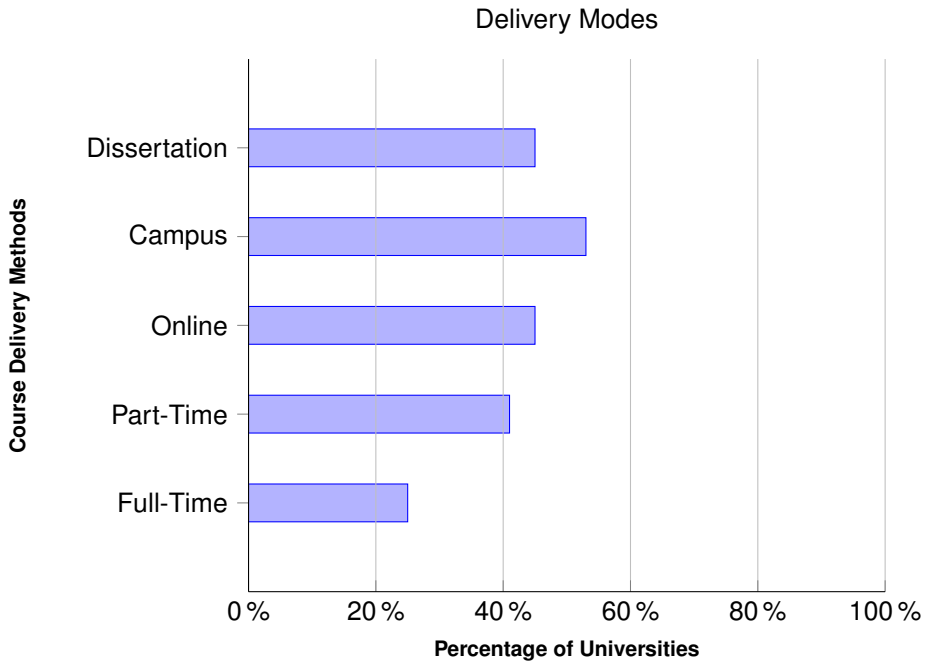


Figure 32: ASEM Members Delivery Method against Universities

4.5.3 Subjects

The coursework in line with UJ and the equivalents as collected in Chapter 3.

Table 14: Subjects by ASEM Listed Universities (Summary of Appendix Q)

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
Total 172	**147**	**130**	**149**	**161**	**114**	**110**

ASEM is one of the leading engineering management associations globally. The results of ASEM program list are as follows in Figure 33:

- Project Management - 85%
- System Engineering - 76%
- Engineering Economics - 87%
- Engineering Management - 94%
- Product Development and Marketing - 66%
- Reliability Engineering - 64%

The subject Engineering Management leads the study with 94%, followed by Engineering Economics with 87%, Project Management with 85%. System Engineering is increasing in popularity as a subject.

A study by (Wasserman, 2014) reported deficient percentage for Systems Engineering. The last review is Product and Development and Reliability.

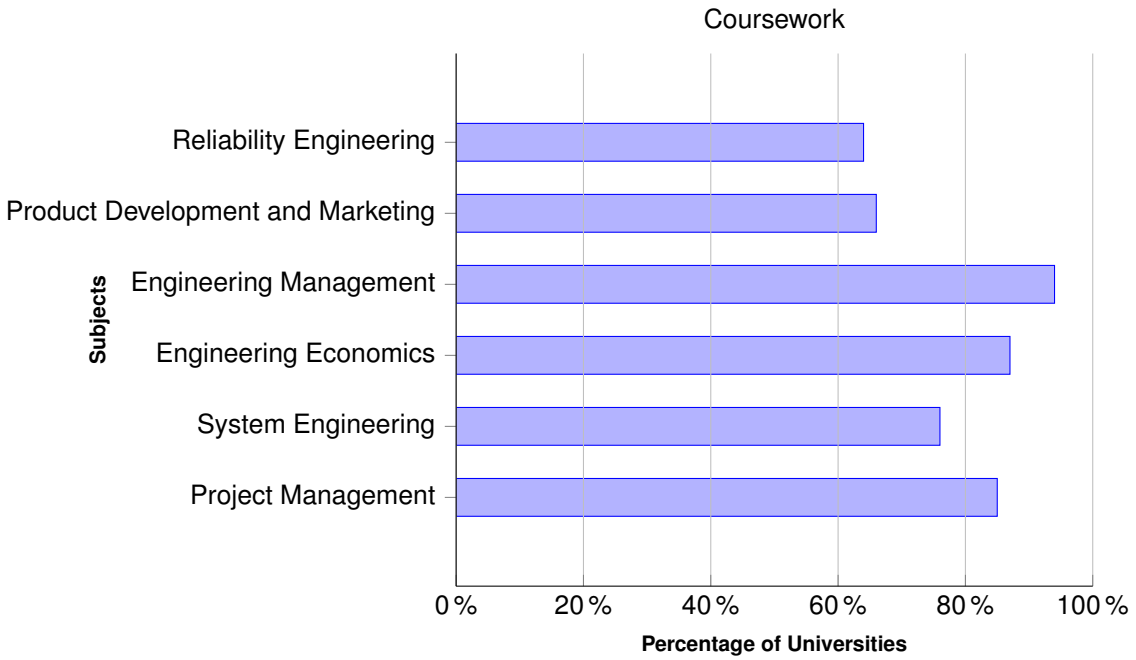


Figure 33: ASEM Subjects against Universities

4.6 Total Combined Results

4.6.1 Degrees

Table 15: Combined Quota Sample Degrees

Groups	**Master's Course**	**PhD Course**	**Bachelor's Course**
SA	100%	80%	0%
ASEM	87.79%	8.72%	27.33%
ASEM (Non-American)	70.97%	12.90%	0%
U21	84%	8%	8%
Average	**85.69%**	**27.41%**	**8.83%**

The entire analysis of data collected reveals on average that engineering management offering at Master's Level is at 86% of universities studied. This signals that a Master's degree in Engineering Management is the most popular offer, with PhD following at 27% and Bachelor of Science (BS) at 9%. The results presented for all the universities are on average.

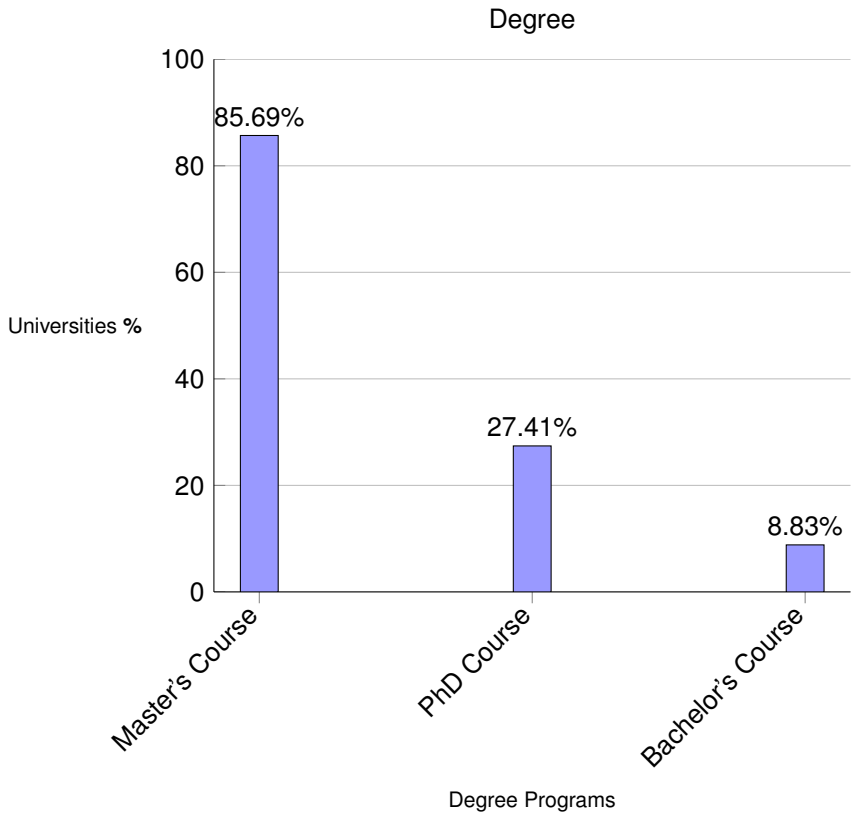


Figure 34: Total Universities Average Degrees

4.6.2 Delivery Methods

Table 16: Combined Quota Sample Delivery Method with Dissertation Options

Groups	Full-Time	Part-Time	Online	Campus	Dissertation Option
SA	80%	100%	60%	100%	100%
ASEM	25%	41%	45%	53%	45%
ASEM(Non-American)	23%	10%	3%	13%	45%
U21	44%	44%	16%	52%	36%
Average	**42.90%**	**48.74%**	**31.00%**	**56.60%**	**56.48%**

On average, universities are well capacitated to offer the dissertation option as a form delivery method at 56%. The online option is a new method that is coming onto the scene of academia for engineering management. It still shows that the transition towards internet of things is starting to creep towards growth as revealed by the ASEM universities with 45%: the numbers are leaning towards online offerings followed by part-time at 41% and full-time 25%. In this instance, the online offering is the challenger, and the campus offering is the defender.

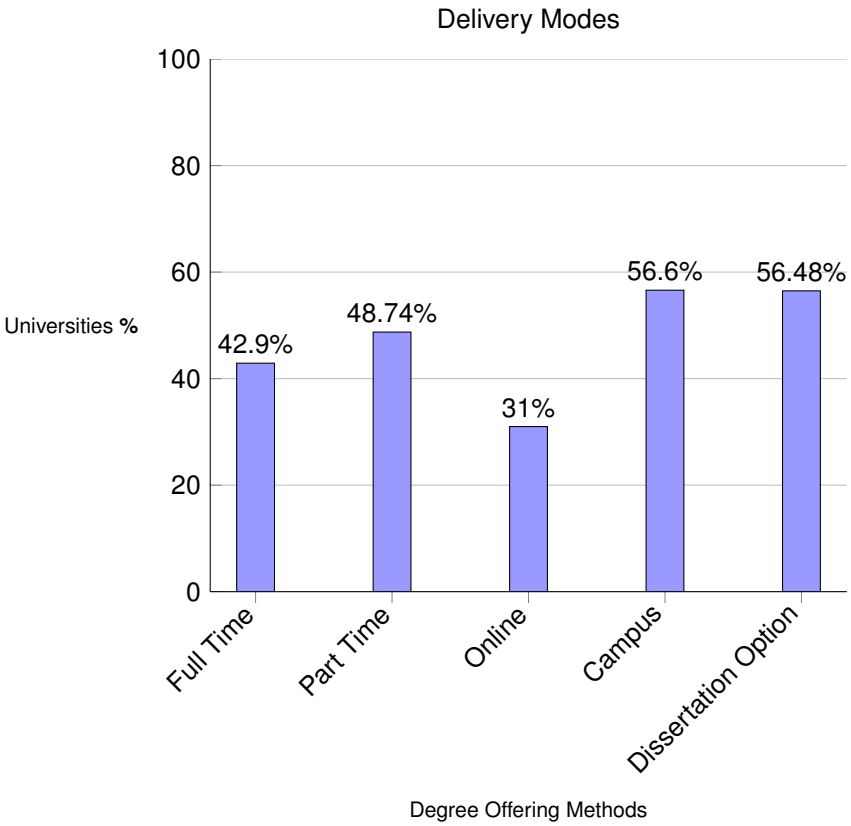


Figure 35: Total Universities Average Delivery Methods

4.6.3 Subjects

Table 17: Combined Quota Sample Subjects

Groups	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
SA	**80.00%**	**80.00%**	**80.00%**	**80.00%**	**40.00%**	**60.00%**
ASEM	**85%**	**76%**	**87%**	**94%**	**66%**	**64.00%**
ASEM (Non-American)	**55%**	**55%**	**35%**	**58%**	**48%**	**48%**
UNI21	**88.00%**	**64.00%**	**72.00%**	**92.00%**	**52.00%**	**44.00%**
Average	**77.08%**	**68.61%**	**68.53%**	**80.92%**	**51.67%**	**54.09%**

Analysing the average subject offerings reveals the following:

- Engineering Management - 81%
- Project Management - 77%
- System Engineering - 69%
- Engineering Economics - 69%

These are the principal subjects offered in engineering management and also determine the skills required by engineering managers. They are followed by Product Development and Marketing and Reliability Engineering at 52% and 54% respectively.

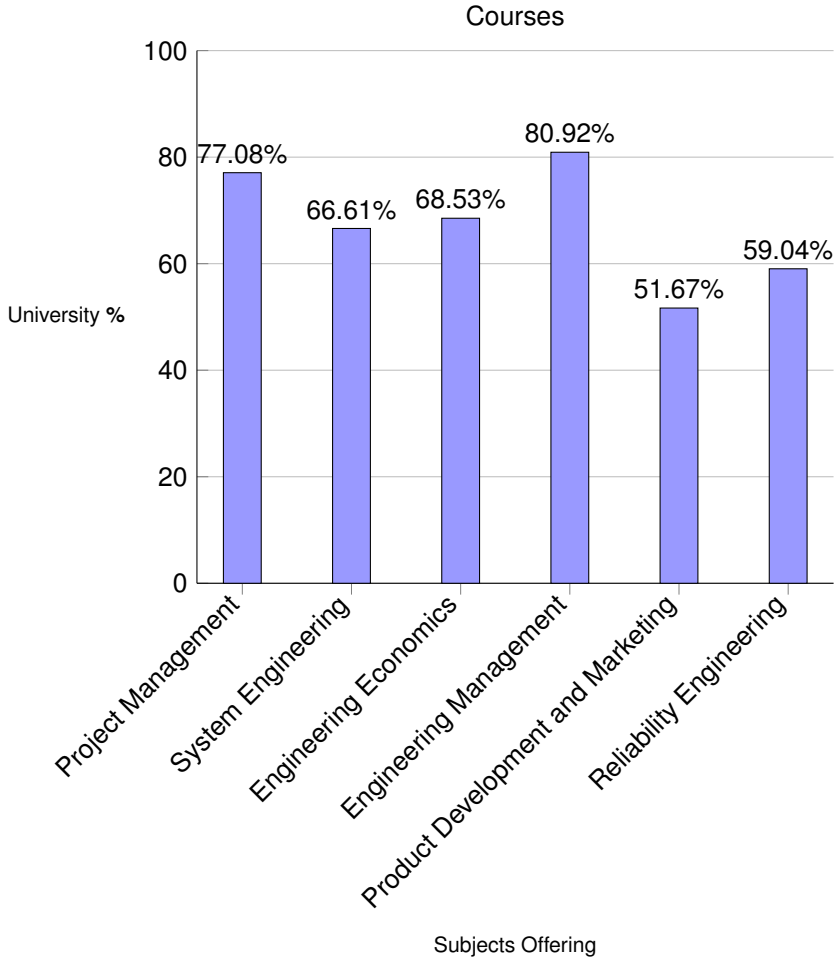


Figure 36: Total Universities Average Subjects Offering

4.6.4 ECSA Registration Trends - South Africa

Engineering plays an important role in the community to the extent that it requires a regulator. In South Africa, the engineering regulator is the ECSA, which acts as an approved regulatory body. The ECSA, the overseer, agrees on the academic engineering programmes and engineers in practice. Upon registration the designators may be used in the following manner: Professional Engineer (Pr Eng), Professional Engineering Technologist (Pr Tech Eng), Professional Engineering Technician (Pr Techni Eng), Professional Certificated Engineer (Pr Cert Eng) (Engineering Council of South Africa, 2015). Every year, the Engineering Council of South Africa keeps records of registered people in the engineering profession. The Table 18 lists the numbers collected over six years.

Table 18: ECSA Registrations over 6 Years

Annual Financial Year	2010 - 2011	2011 - 2012	2012 - 2013	2013 - 2014	2014 - 2015	2015 - 2016
Registrations	2349	3914	2547	2842	1839	4203

The ECSA analysis of registered people has a purpose of finding out the trends of engineering qualifications as a whole. Refer to Table 18. These registered people have a potential to enrol for the Masters in Engineering. As a result, these increases create high demand for the university to fulfil, while registrations increase. Refer to Figure 37.

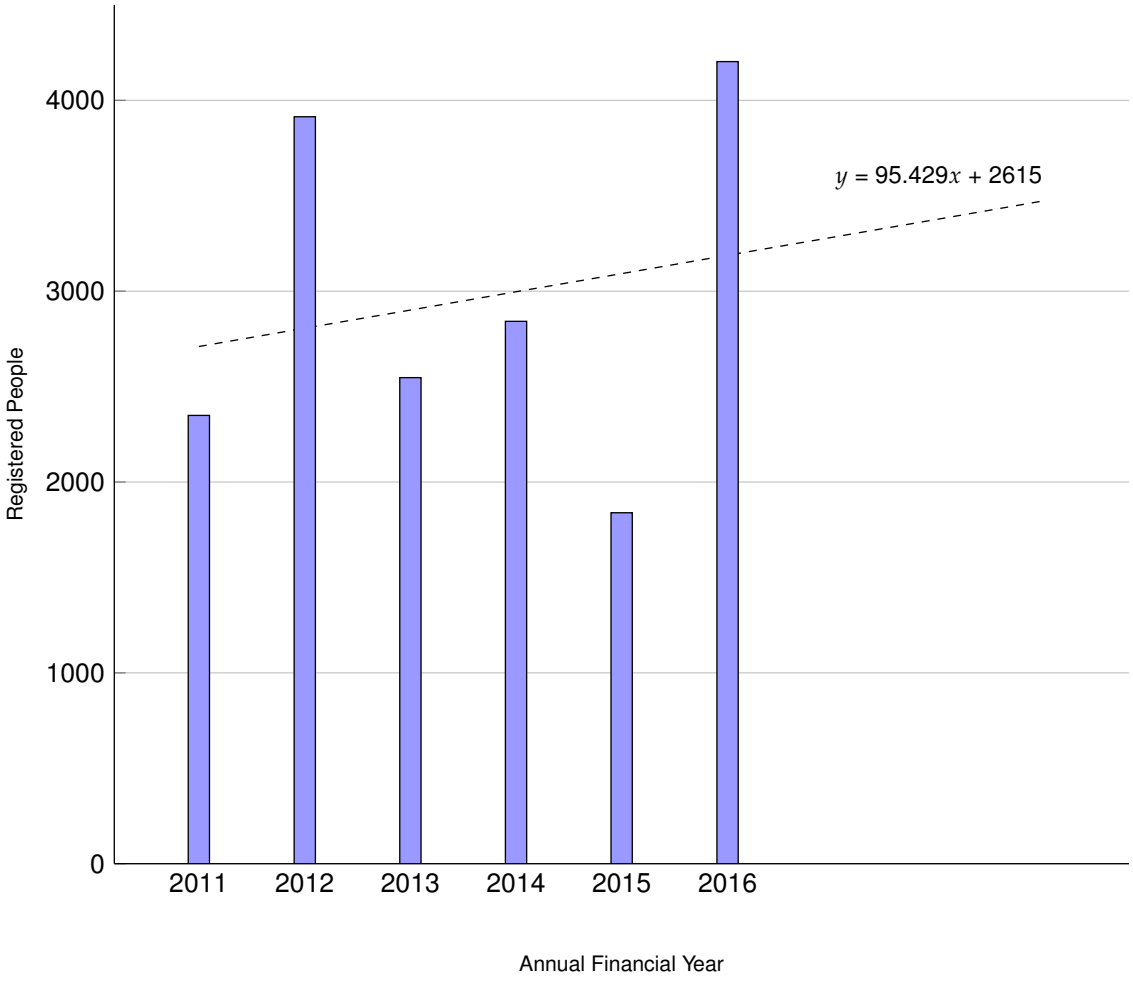


Figure 37: ECSA Registration Chart for 6 Year Period

According to ECSA (2013), national engineering skills survey results; engineers opt to take postgraduate studies in business management while Project Management is the second preference and offered at postgraduate level. Project Management is one of the courses in the Engineering Management Master's course and a subset of the Engineering Management Knowledge Domain (Shah *et al.*, 2015).

4.6.5 Further Analysis Beyond University of Johannesburg's Scope

The criteria are modelled into levels according to Figure 38 to evaluate the results further. This model outlines findings that were not part of the study, but appear to be valid for the research analysis on Engineering Management courses. The analysis will be on:

- Master's ratio to Doctoral Degrees

- Faculty
- Global Zoning

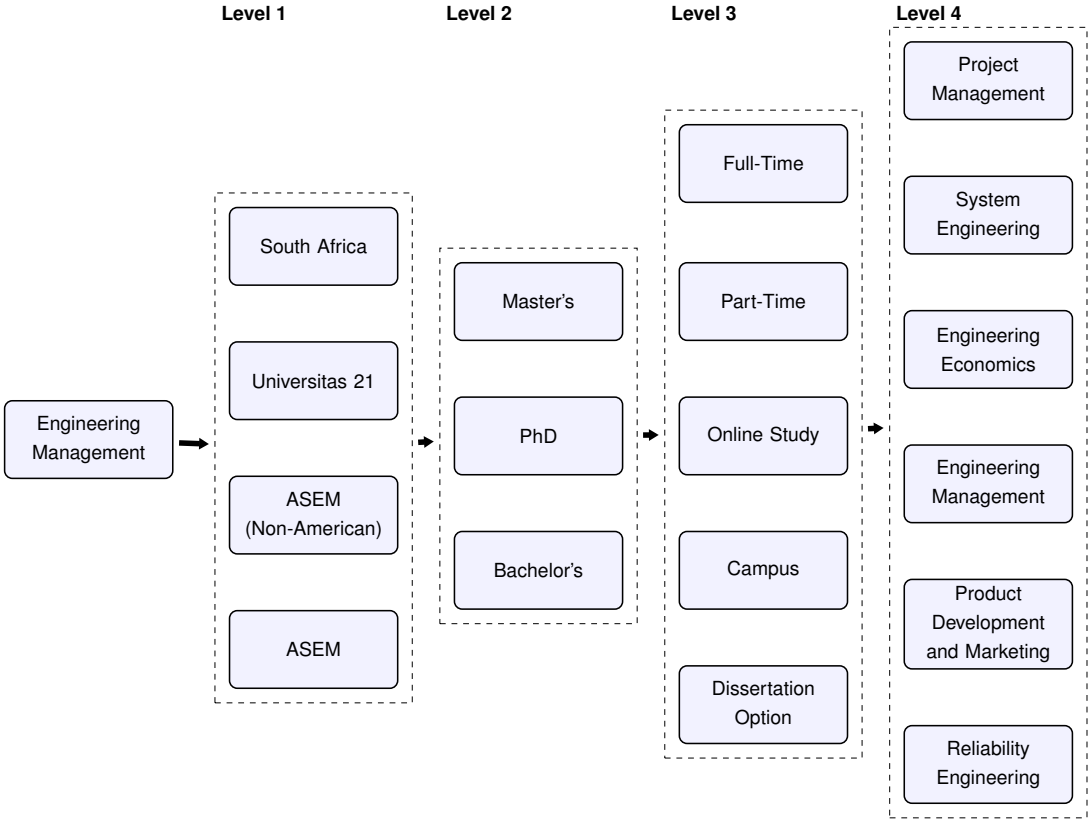


Figure 38: Segments of Sample Size

The levels description is as follows:

Level 1

South Africa: The first launcher of Master's in Engineering Management Degree in South Africa is the University of Pretoria. Only five universities offer Engineering Management or equivalent at Master's Level in South Africa (Garg and Rajah, 2012).

Universitas 21: The University of Johannesburg is a member of Universitas 21. This group of universities contributes collectively academically to determine the latest trends and promote best practices in research. There are 25 universities in this group.

American Society of Engineering Management (Non-American): The universities in this category are affiliates of ASEM but are not in the USA. One of the universities that guide the study is the University of Johannesburg.

American Society of Engineering Management: The ASEM stronghold is in the USA, and these universities are in the USA.

Level 2

Degrees offered at Master's, Doctoral and Bachelor's level in Engineering Management.

Level 3

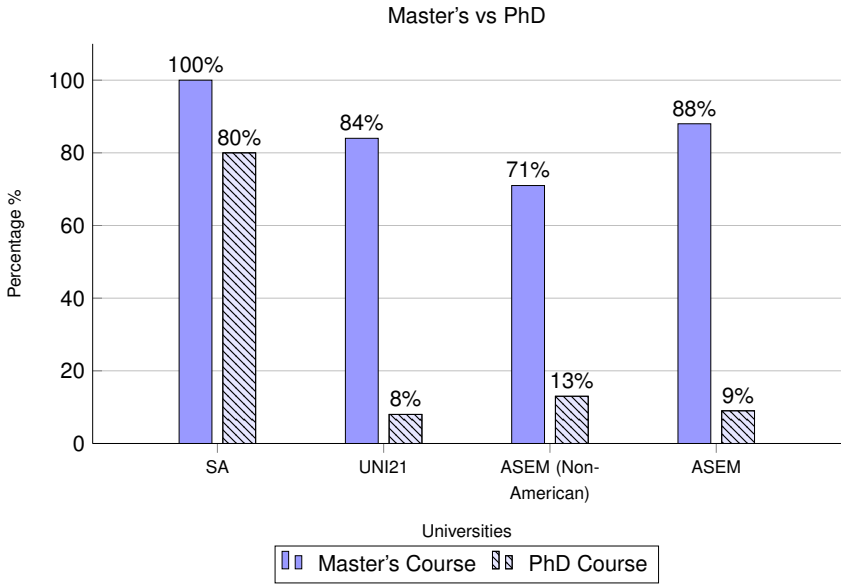
Degree delivery methods by full-time or part-time studies. The dissertation option with the online option is a subset of this level.

Level 4

Subjects offered coursework, according to the University of Johannesburg's curriculum.

4.6.6 Master's Course against Doctoral Course

Unique to this analysis, consideration is on postgraduate degrees. PhD's account for all the doctoral degrees analysed. The Level 1 vs Level 2 analysis revealed the comparison of Master's to Doctoral degrees; the majority of universities offer a Master's in Engineering Management. That pushes the qualification to be at postgraduate level. See Figure 39. Results also indicate a significant percentage of SA institutions offering the PhD programmes compared to other groupings while the number of universities studied is five.



	SA	UNI21	ASEM(Non)	ASEM
Master's Course	100%	84%	71%	88%
PhD Course	80%	8%	13%	9%

Figure 39: Master's versus Doctoral Degree

4.6.7 Faculty per Programme

The word faculty has definitions and explanations by numerous dictionaries. The (Stevenson, 2010) defines faculty as:

- ”A group of university departments concerned with a major division of knowledge.”
- ”The teaching staff of a university or college, or of one of its departments or divisions, viewed as a body.”

For this analysis, the faculty comprises of members of the academic staff as specified by the university code as Professor, Associate Professor, Doctor (Dr) and lecturing staff. The employed staff deliver the course content as prescribed by the university. The analysis of faculty was feasible for South Africa and the United States of America as of 05th April 2017. The research assumed the faculty to be permanently appointed staff in the engineering management department. Also, universities have part-time staff who are industry experts in the module or subject offered.

The average comparison determination is by the following method:

$$\text{Average Faculty} = \frac{\text{Total Number of Collected Staff Numbers}}{\text{Total Number of Universities of Collected Data}}$$

South Africa

Table 19: Engineering Management: Faculty to Programme Ratio

University	**Master's Course**	**PhD Course**	**Bachelor's Course**	**Faculty Academic Staff**
University of Johannesburg	MEng/MPhil: Engineering Management	Eng/DPhil: Engineering Management		4
University of Pretoria	MEng/MSc: Engineering Management	DPhil: Engineering Management		12
University of Cape Town	MPhil: Engineering Management	DPhil: Engineering Management		11
Stellenbosch University	MEng: Engineering Management			2
North-West University	MEng: Development & Management	DPhil: Development & Management		
Total 5	**5**	**4**	**0**	**29**
Average Faculty				**7.25**

The ECSA numbers in Table 18 confirm an increase of people with engineering qualifications year on year. The growth of a number of students has an effect on the number of faculty staff to programme ratio. The University of Pretoria University of Pretoria (UP) has a substantial number of faculty staff. According to the results, an average of seven lecturing staff members in Master's Degree in South Africa is a minimum.

Universitas 21

The mapping of faculties using Microsoft Excel tools resulted in faculty representation in this category to be nine on average as per Table 20.

Table 20: Universitas 21 Faculty (Summary of Appendix R)

University	Master's Course	PhD Course	Bachelor's Course	Faculty Academic Staff
Total 25	21	2	2	**17**
Average Faculty				**8.5**

ASEM (Non-American)

ASEM (Non-American) is an extension category of ASEM, out of 25 universities analysed, the result revealed an average number of faculty staff to 14. The list of the faculty was accessible for two universities, the results in Table 21 are by the following method:

$$\text{Average Faculty} = \frac{\text{Total Number of Collected Staff Numbers}}{\text{Total Number of Universities of Collected Data}}$$

Table 21: ASEM (Non -American) Faculty (Summary of Appendix S)

University	Master's Course	PhD Course	Bachelor's Course	Faculty Academic Staff
Total 31	22	4	0	**27**
Average Faculty				**13.5**

ASEM (The United States of America)

The Python and Microsoft Excel tools were adopted to review the faculty members per institution. The tool was limited to extracting updated web specific data, as listed by each institution. The results, as appended in Appendix T, indicate a 100% extraction from the population. The universities in this category have a grounded Engineering Management faculty. The analysis shows the average teaching staff or faculty as 13, which is high because some of the universities offer Engineering Management at the undergraduate level, as opposed to the South African region. Some of undergraduate courses are greater than some of PhD courses in the USA.

Table 22: ASEM: Faculty to Programme Ratio (Summary of Appendix T)

University	Master's Course	PhD Course	Bachelor's Course	Faculty Academic Staff
Total 172	151	15	47	**949**
Average Faculty				**12.6533**

Representation on Faculty per Segment

The faculty comparison reveals the following contribution per Level 2, Level 3 and Level 4 to Level 1 with regards to faculty staff. The global representation faculty to Master's and PhD ratio in Table 23 illustrates 3% for South Africa, 2% for Universitas 21, 3% for ASEM (Non-American) and 93% for ASEM. The bulk of the total skill in engineering management is in the USA.

Table 23: Faculty Representation

	Master's Course	PhD Course	Bachelor's Course	Actual Faculty Staff	Average Faculty Staff	Faculty representation
SA	5	4	0	29	7	3%
UNI21	21	2	2	17	9	2%
ASEM (Non-American)	22	4	0	27	14	3%
ASEM	151	15	47	949	13	93%
Total	**199**	**25**	**49**	**1022**		

4.6.8 Continental Zoning

The geographical presentation of the universities sharing a relationship with the University of Johannesburg. The plotted dots indicate the country and continent of each studied university. Affiliation organises the universities and countries to both U21 and ASEM. The global representation is significant in this analysis to indicate the position of the University of Johannesburg's engineering management course.

Universitas 21

The plots in Figure 40 indicate the cluster of engineering management courses from 23 universities with U21 membership to be well represented in North America and Europe with six universities on each continent. Asia follows this representation with five universities. The concentration below the equator is low in numbers, with four Australian universities, one African university, and one South American university.

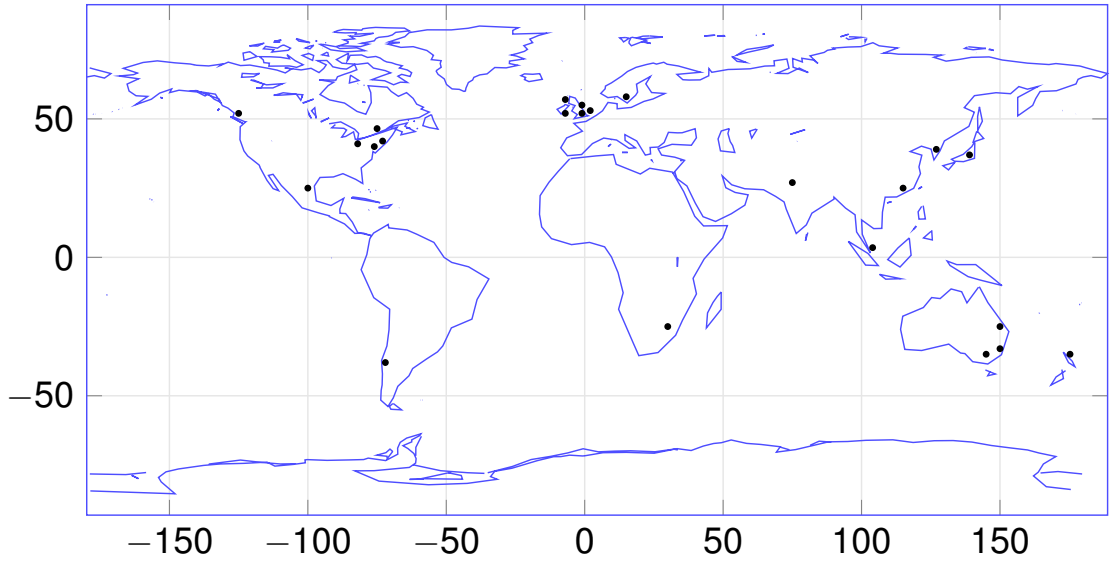


Figure 40: Universitas 21 Engineering Management Global Cluster

ASEM (Non-American)

The ASEM (Non-American) members cluster plots from Figure 41 indicate that Europe is dominant in the field of engineering management with 18 universities out of 19 countries as opposed to one university-affiliated. The numbers show the ratio of Africa to Europe to be 6% representation. Africa is currently represented by the University of Johannesburg.

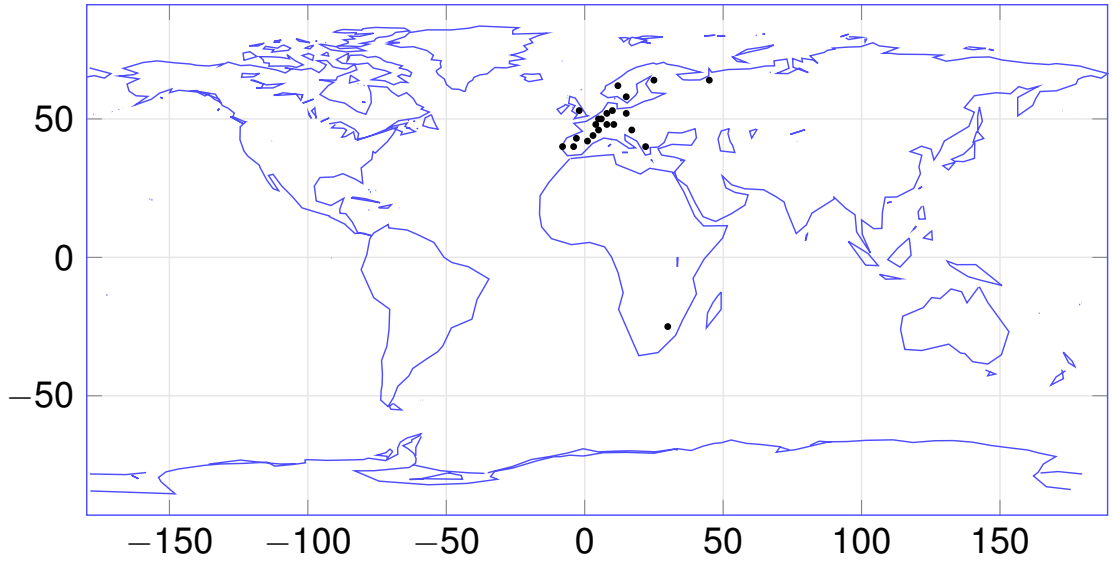


Figure 41: ASEM (Non-American) Engineering Management Global Cluster

4.6.9 Additional Modules

Total Universities and Numbers Offering Each Course

Table 24: Subjects by Total Universities

	Universities	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
SA	**5**	**4**	**4**	**4**	**4**	**2**	**3**
ASEM	**172**	**147**	**130**	**149**	**161**	**114**	**110**
ASEM (Non-American)	**31**	**17**	**17**	**11**	**18**	**15**	**15**
UNI21	**25**	**22**	**16**	**18**	**23**	**13**	**11**
Totals	**233**	**190**	**167**	**182**	**206**	**144**	**139**
Percentage Representation Relative to the Total							
SA	2.15%	2.11%	2.40%	2.20%	1.94%	1.39%	2.16%
ASEM	73.82%	77.37%	77.84%	81.87%	78.16%	79.17%	79.14%
ASEM (Non-American)	13.30%	8.95%	10.18%	6.04%	8.74%	10.42%	10.79%
UNI21	10.73%	11.58%	9.58%	9.89%	11.17%	9.03%	7.91%

These subjects are a signal of the curriculum determination for engineering management. On average, 171 universities studied have the same or equivalent subjects to the University of Johannesburg. Figure 42 points out the distribution on a waterfall for the subjects offered by universities.

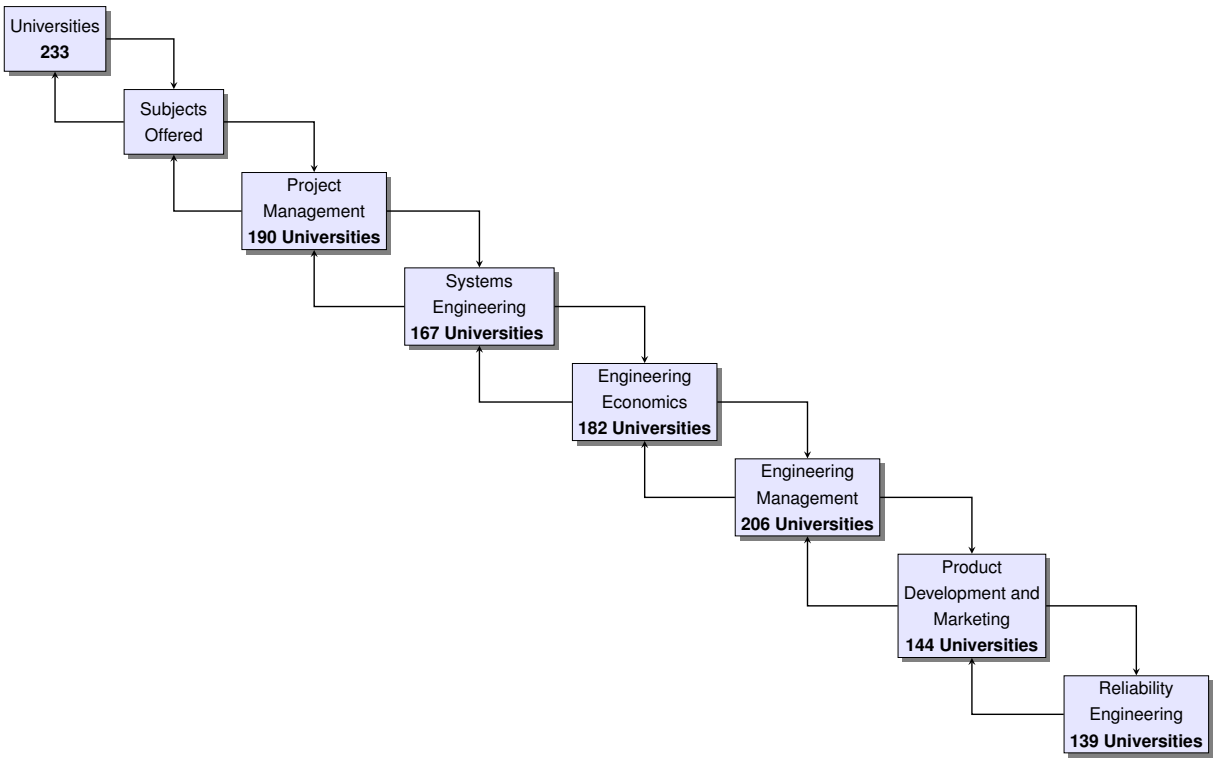
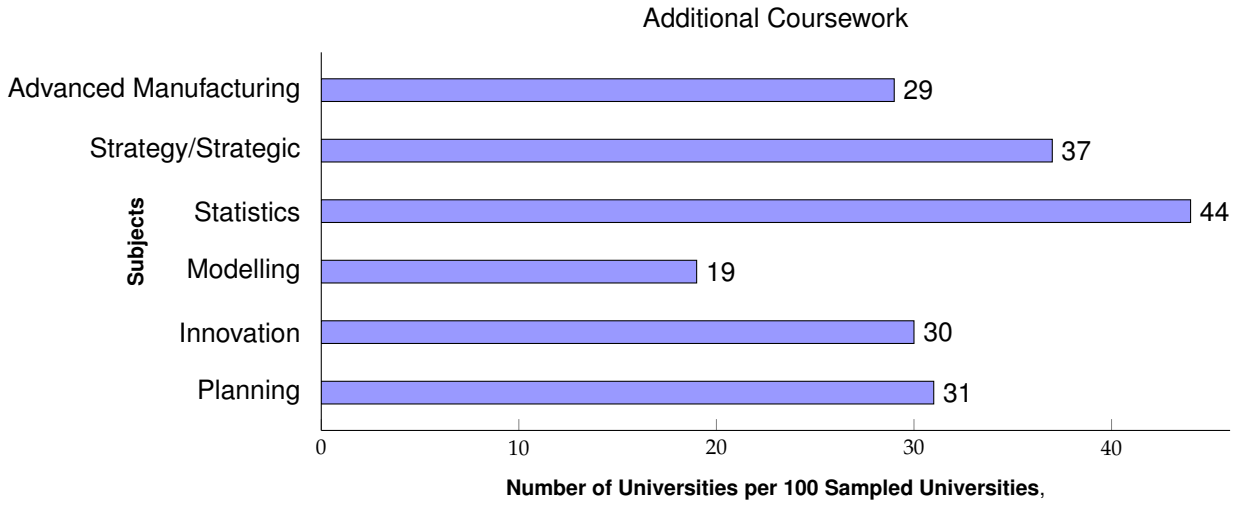


Figure 42: Universities Numbers per Subject Offered

ASEM Universities

The North American universities have a grounded establishment in Engineering Management courses, with a significant presence of affiliations with ASEM. The universities in this segment offer a wide variety of courses in their course-work options. Unique to this analysis of Engineering Management, the following keywords in the modules were selected: Planning, Innovation, Modelling, Statistics, Strategy, and Advanced Manufacturing, as illustrated in Figure 43. It is apparent that Planning, Innovation, Statistics and Advance Manufacturing are surfacing as additional options for coursework in Engineering Management.



	Planning	Innovation	Modelling	Statistics	Strategy	Advanced
Universities	31	30	19	44	37	29

Figure 43: Additional Engineering Management Subjects

The shift in the modules or subjects offering is prevalent as represented by the analysis of modules beyond the University of Johannesburg's subjects. The results indicate that the EMBOK knowledge domains may be the subject of discussions with the upcoming release.

4.7 Conclusion

The results reveal the engineering management qualification has a footprint in the management field. The levels show an acceptable percentage of the subject offerings while the observation on Master's degree is also high in percentages. Nonetheless, the online offering is gaining traction, but can only be achievable with the Internet. There remains a setback of slow internet speeds in some countries, especially in Africa. Most of the universities do not publish information on the courses offerings which presents a challenge in attracting potential students and encouraging them. Additionally, the design of the websites is so complex that navigation is sometimes tedious.

The results revealed the need for adjustment on engineering management from universities and the industry where necessary. Engineering management stands a good chance of becoming one of the prominent fields in the industry. The techniques the universities use in facilitating courses need

continuous improvement. The industry is evolving, and engineering managers need to be aware of their surroundings and stay abreast of trends and changes.

The European countries have a fair amount of the population represented in both U21 and ASEM (Non-American) as opposed to other countries. The Asian countries also are well represented, followed by Australia. The only representation from Africa is South Africa with the University of Johannesburg.

Chapter 5

Conclusion

After the review of the results in Chapter 4, this chapter will provide the final recommendation on the future of engineering management. The research aimed to review the South African universities, U21, ASEM and global engineering management offerings. All the set conditions look to the University of Johannesburg for guidance on finding out the evolving courses and delivery methods.

5.1 Answers to Research Questions

What are the current global universities offering engineering management and in what formats?

The universities offer Master's in engineering management and categorise the qualification to be at postgraduate level. While engineering management at an undergraduate level is popular in the USA, it still lags relative to the Master's Level. Some universities still offer the degree in the traditional way of full-time study, while others are offering dissertation only. The coursework with minor dissertation is gaining popularity, from the results of the number of subjects studied from various universities. The dissertation by itself is at an average of 56% while coursework is at 67%.

What are the specific university courses defined by international best practice, unique to engineering management?

The following subjects depict the foundation of engineering management offerings. ASEM has defined the domain of engineering management which is addressed by the listed module below (Shah *et al.*, 2015):

- Engineering Management - 81%
- Project Management - 77%
- System Engineering - 69%
- Engineering Economics - 69%
- Reliability Engineering - 54%
- Product Development and Marketing - 52%

These are the offered subject in Engineering Management. The results reveal the skill set required by engineering managers. The engineering field is no longer about finding answers to problems alone. Considering alternatives plays a role in the functions of the engineer. These courses are a determining factor of the actual duties and skills of engineering Managers (Io Storto, 2008).

What are the trends of engineering management offerings from universities in SA and globally?

The delivery styles; course work, dissertation globally and in South Africa are at approximate equal strength. The online delivery method is growing because some universities offer engineering management courses online only, using web transmission and studying at a pace decided by the student. With the online offering method becoming an option, full-time studies will slowly fall away as we get better Internet speeds of transmitting data and streaming. The ASEM results of the universities in the USA, confirm that 25% full-time, 41% part-time, 45% online, and 45% dissertation. The percentage of the full-time offering is less than the online offering. The concept of the Internet of Things is real, and it will take over in the future where students and lecturers will not have to be on campus for lectures. Also, the student will be able to attend a class anywhere in the world through the internet.

On average 56% of studied Universities are capacitated to offer dissertation as a delivery method. The online option is the new method that is coming into the scene of academia for Engineering Management at 31%. The numbers are leaning towards online offerings while Full-Time and Part-Time are distributed at 43% and 49% respectively, linking with campus model of offering at 55%.

What makes the University of Johannesburg relevant in offering the Engineering Management Degree?

The criteria set for the research revealed an average of 65% to 75% standing results. The results suggests that the University of Johannesburg is not far off from the rest of the world. The results confirm that out of fifteen measures, the University of Johannesburg met fourteen, which is 93%. Indeed, engineering management at the University of Johannesburg is relevant.

5.2 Limitation

This study is about the South African universities, members of Universitas 21, and universities affiliated with the American Society of Engineering Management as of the 05th April 2017.

5.3 Future Research

This research is central to a specific group; more universities offering Engineering Management that are not in same affiliations with the University of Johannesburg. A further research investigation would be to find out the best practice and the standing of engineering management on excluded universities and comparing the findings of this study.

5.4 Value Added

The research can aid the universities considering offering engineering management degrees to see where the academic world is heading, and what is needed to align with the rest of the world. Businesses can use the research to see what skills sets are required by engineering managers to be competitive in the market and to perform the management functions.

5.5 Summary and Conclusion

The research shows that universities offer engineering management as a management course for engineers. The global representation is high in the United States of America, followed by Europe, Asia and Australia. The African continent is also a representation, mainly in South Africa. It is evident from the collected data that the course delivery methods are to enhance the skills set required by engineering manager. The available delivery options are available in different forms with on-campus studies a conventional method being challenged by online studies. The part-time and full-time methods still exist at various universities with dissertation options. The effectiveness of these methods of delivery are evident by the numbers of universities opting to employ any of the delivery methods collected during the study.

Engineering management is a breath-taking philosophy when well understood. A focus on learning and adoption of new learning techniques is another revolution reaching universities. The learning brings about staying abreast of trends and making sure that what is studied is current. Engineering management breaks the barrier of engineers thinking and decision-making and has changed the career life of an engineer from contributor to ownership. Effective training programmes are needed for engineering managers to be a success, both on the job and in-class training. They will improve the undergraduate training already received. The analysis of subjects and universities uncovered the skills set needed by engineering managers in conjunction with the Engineering Management Knowledge Domain. The literature on the functions of engineering managers confirms the skill set required. The discovery concludes that engineering managers without proper management training stand a chance of failing in their duties.

The use of the Internet and cyber-technology is a modern day practice that is taking the world to a new level. As well as cyber-technology, the Internet is taking the world by storm, which brings about the Internet of Things as a tool of performance in recent days. The national governments may be required to expedite the roll-out of the latest Internet transmission methods like fibre optics to support the Internet of Things.

The study shows that African countries need to consider aligning with the rest of the world to keep up with current trends in the engineering management subset. The shift in the way of doing things is the current dilemma facing most African countries. Hence they are mostly adapting late to modern trends and global demands. The demand is evident by affiliation with international bodies such as ASEM. The University of Johannesburg's presence in affiliations such as ASEM confirms the relevance of engineering management degree offered by the university.

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Appendix A

Universitas 21 Members

1. University of Melbourne
2. University of Queensland
3. UNSW Australia
4. University of British Columbia
5. McGill University
6. Pontificia Universidad Catlica de Chile
7. Fudan University
8. University of Hong Kong
9. Shanghai Jiao Tong University
10. University of Delhi
11. University College Dublin
12. Tecnolgico de Monterrey
13. University of Auckland
14. National University of Singapore
15. University of Johannesburg
16. Korea University
17. Lund University
18. University of Amsterdam
19. University of Birmingham
20. University of Edinburgh
21. University of Glasgow
22. University of Nottingham
23. University of Connecticut
24. University of Maryland
25. The Ohio State University

Appendix B

American Society for Engineering Management: Non-American

1. Institut fur Managementwissenschaften
2. Universiteit Gent
3. Univ. of Split
4. Center for Industrial Production
5. Helsinki University of Technology
6. Tanpere University of Technology
7. Ecole des Mines de Saint-Etienne
8. Institut National Polytechnique de Grenoble
9. Chemnitz University of Technology
10. Institut fur Fabrilbetriebslehre und Unternehmensforschung
11. Ruhr Universitat Bochum
12. Technische Universitat- Dortmund
13. University of Bremen
14. National Technical University of Athens
15. Fraunhofer Projektkzpont a SZTAKI-ban
16. Politecnico di Bari
17. Politecnico di Milano
18. Ss Cyril and Methodius University in Skopje
19. Norwegian University of Science and Technology
20. Politechnika Warszawska
21. Poznan University of Technology
22. Wroclaw University of Technology
23. Instituto Politecnico
24. St. Petersburg Institute

25. University of Johannesburg
26. Centro Politecnico Superiorde Ingenieros
27. Polytechnics of Madrid
28. Universidad de Valladolid
29. Linkoping Institute of Technology
30. Aston University

Appendix C

American Society for Engineering Management: EM-Program-List

1. University of Alabama - Birmingham
2. University of Alabama - Huntsville
3. University of Alaska - Anchorage
4. University of Alaska - Fairbanks
5. Arizona State University
6. Northern Arizona University
7. University of Arizona
8. Arkansas State University
9. University of Arkansas
10. California State Polytechnic University - Pomona
11. California State University - East Bay
12. California State University - Long Beach
13. California State University - Northridge
14. National University
15. Northcentral University
16. Santa Clara University
17. Stanford University
18. University of California - Los Angeles
19. University of California - Riverside
20. University of Southern California
21. University of the Pacific
22. University of California, Irvine
23. Colorado School of Mines
24. Colorado State University

25. University of Colorado - Boulder
26. University of Colorado - Colorado Springs
27. University of Denver
28. Central Connecticut State University
29. Fairfield University
30. University of Bridgeport
31. University of Connecticut
32. University of Hartford
33. University of New Haven
34. Catholic University of America
35. Georgetown University
36. George Washington University
37. Florida A& M University / Florida State University (FAMU-FSU)
38. Florida Institute of Technology
39. Florida International University
40. University of Central Florida
41. University of South Florida
42. Georgia Tech
43. Mercer University
44. University of Idaho
45. Northwestern University
46. Southern Illinois University
47. University of Illinois at Urbana-Champaign
48. University of Illinois - Chicago
49. Indiana Institute of Technology
50. Indiana State University
51. Purdue University
52. Rose-Hulman Institute of Technology
53. Trine University

54. Valparasio University
55. Iowa State University - Ames
56. Kansas State University
57. University of Kansas
58. Wichita State University
59. University of Louisville
60. Western Kentucky University
61. Louisiana Tech University
62. McNeese State University
63. Southern University and A & M College
64. University of New Orleans
65. University of Southwestern Louisiana
66. John Hopkins University
67. University of Maryland - Baltimore County
68. Merrimack College
69. Northeastern University
70. Tufts University
71. University of Massachusetts - Amherst
72. University of Massachusetts-Lowell
73. Western New England University
74. Worcester Polytechnic Institute
75. Eastern Michigan University
76. Kattering University
77. Lake Superior State University
78. Lawrence Technological University
79. Michigan Technological University
80. Oakland University
81. University of Detroit - Mercy
82. University of MichiganDearborn

83. Wayne State University
84. Western Michigan University
85. Saint Cloud State University
86. University of Minnesota - Duluth
87. University of Minnesota
88. University of Saint Thomas
89. Missouri University of Science & Technology
90. Southeast Missouri State University
91. University of Central Missouri
92. Washington University - St. Louis
93. Montana State University
94. Montana Tech
95. University of Nebraska - Lincoln
96. Dartmouth College
97. New Jersey Institute of Technology
98. Rowan University
99. The College of New Jersey
100. New Mexico Institute of Mining and Technology (New Mexico Tech)
101. Clarkson University
102. Columbia University
103. Cornell University
104. Hofstra University
105. Long Island University
106. New York Institute of Technology
107. New York University
108. Rensselaer Polytechnic Institute
109. Rochester Institute of Technology
110. State University of New York - Stony Brook
111. Stevens Institute of Technology

112. Syracuse University
113. United States Military Academy at West Point
114. Duke University
115. East Carolina University
116. North Carolina A & T State University
117. University of North Carolina - Charlotte
118. North Dakota State University
119. Oklahoma State University
120. Air Force Institute of Technology
121. Case Western Reserve University
122. Miami University
123. Ohio University
124. University of Akron
125. Bowling Green State University
126. University of Dayton
127. Oregon State University
128. Portland State University
129. University of Portland
130. Bucknell University
131. Carnegie Mellon University
132. Drexel University
133. Gannon University
134. Lehigh University
135. Pennsylvania State University - Harrisburg
136. Pennsylvania State University - University Park
137. Point Park University
138. Robert Morris University
139. Temple University
140. University of Pennsylvania

141. Widener University
142. Wilkes University
143. York College
144. Polytechnic University of Puerto Rico
145. The Citadel Military College of South Carolina
146. University of South Carolina - Upstate
147. Augustana College
148. South Dakota School of Mines & Technology
149. Christian Brothers University
150. Lipscomb University
151. University of Tennessee - Chattanooga
152. University of Tennessee Space Institute
153. Lamar University
154. LeTourneau University
155. Saint Mary's University
156. Southern Methodist University
157. Texas A & M University - College Station
158. Texas Tech University
159. University of Houston
160. University of Texas - Arlington
161. University of Texas - Austin
162. University of Texas-Pan American
163. Old Dominion University
164. Virginia Tech (Virginia Polytechnic and State University)
165. University of Vermont
166. Gonzaga University
167. Saint Martins College
168. Washington State University
169. Marshall University

170. Marquette University

171. Milwaukee School of Engineering

172. University of Wisconsin - Madison

Appendix D

Best Masters Website

Table 25: Engineering Management: Best Master's Studies (Keystone Academic Solution, 2017)

Degree	University
Master of Engineering Management	United Arab Emirates University, College of Engineering
MSc in Supply Chain Engineering and Management	Jacobs University
Master of Science in Engineering Management (M.S.)	The George Washington University - School of Engineering & Applied Science
Master in Service Management and Engineering (part-time)	HECTOR School of Engineering and Management
Master in Energy Engineering and Management (part-time)	HECTOR School of Engineering and Management
MSc/PgDip/PgCert in Operations Management in Engineering	University of Strathclyde: Faculty of Engineering
Master in Electronic Systems Engineering and Management (part-time)	HECTOR School of Engineering and Management
MD Management Engineering (taught in English or Italian)	University Of Bergamo
Management Engineering	Politecnico di Milano
Master of Engineering (Engineering Management)	University of South Australia
MIT Zaragoza Master of Engineering in Logistics and Supply Chain Management (ZLOG)	Zaragoza Logistics Center
Master of Engineering Science in Engineering Management	UCD College of Engineering and Architecture
MSc Engineering Management	Milwaukee School of Engineering (MSOE)
Master in Software Engineering and Management	Heilbronn University
MSc Engineering Business Management	University of Exeter
Master in Construction Engineering and Management	National Central University
MSc in Systems Engineering (Electronic) & Engineering Management (Single Award)	University of Bolton
MSc in Engineering Management	Frederick University
Master in Environmental Engineering and Management	EOI Spain's School of Industrial Organisation
Master in Environmental Engineering and Management (EEM)	Asian Institute of Technology School of Environment, Resources and Development (SERD)
Master in Manufacturing Systems Engineering and Management (MSEM)	The University of Warwick, Warwick Manufacturing Group WMG

Continued on next page

Table 25 – continued from previous page

Degree	University
MSc in Systems Engineering (Mechatronic) & Engineering Management (Single Award)	University of Bolton
MSc in Systems Engineering (Mechanical) & Engineering Management (Single Award)	University of Bolton
Master of Engineering (ME) - Global IT Management	EPITA Graduate School of Computer Science
MS in Financial Engineering Management	Peter F. Drucker and Masatoshi Ito Graduate School of Management, Claremont Graduate University
MSc Water Engineering Management	University of Exeter
M.Sc. in Management & Engineering in Water	RWTH International Academy / RWTH Aachen University
Master in Industrial & Management Engineering (IMS)	Pohang University of Science and Technology
Master of Engineering in Engineering Management	Rochester Institute of Technology (RIT)
Master of Science in Management and Engineering in Electrical Power Systems (MME-EPS)	Maastricht School of Management
Advanced Engineering Management MSc: Operations Management	Birmingham Business School, University of Birmingham
Master of Engineering Leadership in Resource Engineering Management	University of British Columbia - Faculty of Applied Science
MSc Engineering Management	University of Sunderland
Master in Engineering Management (MSc)	Middlesex University London
Advanced Engineering Management MSc: Project Management	Birmingham Business School, University of Birmingham
Master of Engineering (Environmental Management)	Universiti Teknologi Malaysia
Master in Production Engineering and Management	KTH Royal Institute of Technology
Master Logistics Engineering and Management	Dalian Maritime University
MSc in Sustainability Engineering and Management	Linköping University
Master in Business Engineering - Performance Management & Control	HEC Management School - University of Liége
Master in Business Engineering - Specialization in Supply Chain Management	HEC Management School - University of Liége
Master of Engineering in Health Business Management	Metropolia University of Applied Sciences
MSc in Systems Engineering, Policy Analysis and Management	Delft University of Technology
Applied Master (MSc) in Engineering Business Management	Emirates Aviation University
Master of Engineering Management MEM	London South Bank University
Master in Water Engineering and Management	EOI Spain's School of Industrial Organisation

Continued on next page

Table 25 – continued from previous page

Degree	University
Advanced Engineering Management MSc: Systems Management	Birmingham Business School, University of Birmingham
Advanced Engineering Management MSc: Construction Management	Birmingham Business School, University of Birmingham
MSc in Systems Engineering (Electronic) & Engineering Management (Dual Award), full-time	University of Bolton
Master Management & Engineering	Leuphana University of Luneburg
Production Engineering Management - MSc	Cardiff Metropolitan University
MSc in Industrial Engineering and Management	Linköping University
IT Management Master: Information Systems Engineering And Networks	Institut Africain de Management
Master Of Science In Management-Engineering (Grande Ecole)	Audencia Business School
Master's Degree In Organizational Engineering, Project Management And Business	Universidad Europea de Madrid (UEM)
Master of Engineering in Project Management	University of Maryland, A. James Clark School of Engineering
MSc in Management and Engineering in Computer Aided Mechanical Engineering (MME-CAME)	Maastricht School of Management
M.Sc. Management and Production Engineering - Global Production Engineering and Management	Warsaw University of Technology
MSc in Engineering Management	Manchester Metropolitan University
Master in Engineering Management	Institute Of Business Management
MSc in Engineering Management	University Of Debrecen
MSc in Engineering Management	University of Nicosia
Master in Computer Engineering and Management - taught in FRENCH	University of Mons
Master of Engineering Science in Management of Information System	Transport and Telecommunication Institute
MSc Industrial Engineering and Management	University of Groningen
MSc in Systems Engineering (Mechatronic) & Engineering Management (Dual Award), full-time	University of Bolton
MSc in Systems Engineering (Mechanical) & Engineering Management (Dual Award), full-time	University of Bolton
Master of Science in Engineering Project Management	American University of Ras al Khaimah
Master Course in Coastal and Marine Engineering and Management	Delft University of Technology
Master in Engineering Business Management (EBM)	The University of Warwick, Warwick Manufacturing Group WMG
M. Sc. Management & Engineering in Production Systems	RWTH International Academy / RWTH Aachen University

Continued on next page

Table 25 – continued from previous page

Degree	University
Master in Natural Resources Management and Ecological Engineering	Czech University Of Life Sciences Faculty of Agrobiology, Food and Natural Resources
M.Sc. Management & Engineering in Computer Aided Mechanical Engineering	RWTH International Academy / RWTH Aachen University
Master of Science in Engineering and Management	University of Nova Gorica
MSc in Management and Engineering in Water (MME-Water)	Maastricht School of Management
Master of Industrial Engineering and Innovation Management	Vilnius Gediminas Technical University
Master of Environmental Engineering Management	University of Technology Sydney
Master of Engineering Management	Lawrence Technological University
Master of Engineering Management	University of Newcastle
Master of Engineering Management	University of Technology Sydney
MSc Gas and Engineering Management	University of Salford
Master in Construction Management and Engineering	Delft University of Technology
MS in Traditional Engineering Management	University of Houston - Clear Lake
MSc Industrial Engineering and Operations Management	Nottingham University Business School
Master of Science in Engineering Management	Trine University
Master of Science in Engineering Management	Jönköping University
Master of Engineering Management Master of Business Administration	University of Technology Sydney
Master of Science in Engineering Management	Northeastern University Graduate School of Engineering
Master of Engineering in Industrial Engineering and Systems Management	American University of Armenia
MSc in Management and Engineering in Production Systems (MME-PS)	Maastricht School of Management
M.Sc. Management & Engineering in Electrical Power Systems	RWTH International Academy / RWTH Aachen University
Master of Engineering Management	Kilroy Norway
Master of Science Engineering Management (Awarded by Northumbria Management Development Institute of Singapore (MDIS), UK)	Management Development Institute of Singapore (MDIS)
Master of Science in Industrial Engineering and Management - Strategy	Aalto University
MSc Industrial Engineering and Management	University of Twente
Master of Engineering in Industrial Management	Metropolia University of Applied Sciences
MSc in Risk Management & Financial Engineering	Imperial College Business School

Continued on next page

Table 25 – continued from previous page

Degree	University
MSc Manufacturing Engineering and Management	The University of Nottingham - Faculty of Engineering
MSc Civil Engineering and Management	University of Twente
ME in Civil and Environmental Engineering (Construction Engineering Management Concentration)	Clarkson University Graduate School
Master of Science in Groundwater Engineering and Management	Ajman University
MS IGE - Environmental Management and Engineering	MINES ParisTech
MS GAZ - Gas Engineering and Management	MINES ParisTech
Master of Engineering Master of Engineering Management	University of Technology Sydney
Master's Degree in Management in Polymer Technology	Johannes Kepler University Linz - JKU
Master of Science: Applied Engineering & Technology Management	Eastern Kentucky University
Master in Management and Engineering of Environment and Energy ME3	KTH Royal Institute of Technology
Master of Science in Engineering Management	Al Ghurair University
Master in Global Production Engineering and Management	Vietnamese-German University
Master's Degree In Engineering And Management Of Renewable Energy	School of Continuing Education - Universitat de Barcelona
Double Degree Master's Program in Engineering + Technology Management	NIT Northern Institute of Technology Management
Master of Science in Industrial Engineering and Management	Kaunas University of Technology
Master's Degree Programme in Industrial Engineering and Management	Tampere University of Technology
Master of Science in Industrial Engineering and Management	Aalto University
MTech Construction Engineering and Management	Manipal University Dubai
Advanced Engineering Management MSc (with Specialist Pathways)	Birmingham Business School, University of Birmingham
MPhil in Industrial Engineering and Logistics Management	The Hong Kong University of Science and Technology
MEng / MPhil in Engineering Management (Lectured or Research based)	University of Johannesburg
Master in Engineering Systems Management	St. Mary's University
MSc Construction Management and Engineering	University of Twente
MSc Engineering Projects & Systems Management	Kingston University London

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Table 25 – continued from previous page

Degree	University
Master in Environmental Engineering and Management	Graduate School at Shenzhen Tsinghua University
Safety, Quality, Environment and Risk Management Engineer	ESAIP Graduate School of Engineering
MSc Engineering Management	University of Greenwich
Master of Science program in Management and Engineering in Design Concepts and Structural Engineering of Industrial Facilities (MME-Construct)	Maastricht School of Management
Master of Engineering Leadership in Integrated Water Management	University of British Columbia - Faculty of Applied Science
Master of Science in Engineering Systems Management (MSESM)	American University of Sharjah
Master in Electrical Engineering, Power Engineering and Management	Czech Technical University in Prague
MPhil in Industrial Engineering and Logistics Management (Energy Technology Concentration)	The Hong Kong University of Science and Technology
MSc in Construction Management and Engineering	Eindhoven University of Technology
Master of Science in Engineering Management (MSc)	TU Wien - Continuing Education Center
MSc Oil and Gas Engineering	Brunel University: College of Engineering, Design and Physical Sciences
Master of Technology in Construction Engineering & Management	CEPT University
Master in Applied Engineering and Technology Management	Murray State University
Master in Engineering Management and Logistics	Carlos III University of Madrid
M.Sc. in Management and Engineering in Technology, Innovation, Marketing and Entrepreneurship (MME-Time)	RWTH International Academy / RWTH Aachen University
Master of Science in Engineering Management (MSEM)	Western New England University
Master of Engineering in ConREM - Construction and Real Estate Management(in cooperation with FHTW Berlin)	Metropolia University of Applied Sciences
MSc Management in Construction (Civil Engineering)	Kingston University London
Universitat Rovira i Virgili/Inter-university Master's Degree in Technology and Engineering Management	Universitat Rovira i Virgili
MSc in Environmental Engineering Management	University Of Energy And Natural Resources
MSc in Engineering Systems and Management	Masdar Institute of Science and Technology
Master in Economic Analysis	Jönköping University

Continued on next page

Table 25 – continued from previous page

Degree	University
Total: 143	**Total: 104**

Appendix E

Top University Website

Table 26: Engineering Management: Top University (QS Quacquarelli Symonds Limited, 2017)

University
Queensland University of Techn
The University of Queensland
Universit degli Studi di Pavia
The National University of Sci ...
The University of Warwick
The University of New South Wa ...
McMaster University
Leonard de Vinci Group
Lund University
University of Modena and Reggi ...
Samara State Technical University
Fundacin Universitaria San Pa ...
The Chinese University of Hong ...
Benha University - Egypt
RUDN University
UCL (University College London)
Aalborg University
Glasgow Caledonian University
Carnegie Mellon University H ...
Universidad Carlos III de Madr ...
National University of Singapo ...
Cardiff University
University of South Australia
Technical University of Denmark
Auckland University of Technol ...
The Hong Kong University of Sc ...
University of Johannesburg
ESCP EUROPE - Torino
University of Naples - Federico II
University of Central Lancashire
Peter the Great Saint-Petersbu ...
HK PolyU School of Design
Politecnico di Milano
George Washington University
Waseda University

Continued on next page

Table 26 – continued from previous page

University
Politecnico di Torino
University of Lincoln
Northeastern University
Deakin University
Chalmers University of Technology
Plekhanov Russian University o ...
The University of Auckland
Massey University
The University of Arizona
Universidad Privada del Norte
The University of Adelaide
University of Waterloo
Loughborough University
Universidad Nacional de Colombia
Curtin University
Universit de Lige
Murdoch University
University of Baghdad
Jordan University of Science & ...
Universiti Teknologi MARA - UiTM
Universidade Federal Fluminense
Vilnius Gediminas Technical Un ...
Jiangsu University
Riga Technical University
Bournemouth University
Ecole Polytechnique Fdrale d ...
Northwestern University
University of California, Los ...
The University of Melbourne
Carnegie Mellon University
Technical University of Munich
Delft University of Technology
University of Leeds
The Hong Kong Polytechnic Univ ...
Lancaster University
Aalto University
University of Aberdeen
The University of Exeter
University of Colorado Boulder
Case Western Reserve University
Keio University
Universitt Hamburg
University of Dundee

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Table 26 – continued from previous page

University
University of East Anglia (UEA)
University of Ottawa
Indiana University Bloomington
Universitat Politcnica de Cat ...
University of the Witwatersrand
University of Kansas
Stellenbosch University
Bandung Institute of Technolog ...
University of Oulu
Aix-Marseille University
University of Bordeaux
University of Pretoria
Universit de Sherbrooke
International Islamic Universi ...
Auezov South Kazakhstan State ...
Universitt Duisburg-Essen
Ural Federal University
Ulster University
University of Patras
University of Engineering & Te ...
Auburn University
Universidade Federal de Santa ...
Oklahoma State University
University of Siena
Diponegoro University
Universidad de Valparaso (UV)
JSC S.Seifullin Kazakh Agro ...
University of Belgrade
Universit de Cergy-Pontoise
Abu Dhabi University
University of Brescia
Universit degli studi Gugliel ...
British University in Dubai
University of Shanghai for Sci ...
Finance School AFI
University of Isfahan
Universit degli Studi di Salerno
Universidad Latina de Panam
SRM INSTITUTE OF SCIENCE AND T ...
Southwest State University (Ku ...
Nosov Magnitogorsk State Techn ...
SVKM's Narsee Monjee Institute ...
Warsaw University of Life Scie ...

Continued on next page

Table 26 – continued from previous page

University
UNIVERSIDADE ESTACIO DE S
South Ural State University (N ...
Volgograd State Technical Univ ...
Armenian State University of E ...
LIUC - Universit Cattaneo
TYUMEN STATE OIL AND GAS UNIVE ...
Universidad CEU San Pablo
Tafila Technical University
Ghulam Ishaq Khan Institute of ...
State Higher Educational Estab ...
University of Sarajevo
Qingdao Technological Universi ...
Moscow State University of Edu ...
Montana State University
University of West London
Kyiv National University of Tr ...
Wuhan University of Technology
University of Management and T ...
Rochester Institute of Technol ...
International Technological Un ...
Universitat Internacional de C ...
Total: 142

Appendix F

XPath Script for ASEM Masters Tag

Table 27: XPath Script to Extract Data from ASEM (Master's)

Url	XPath	Master's
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[4]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[10]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[13]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[19]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[22]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[28]/strong	//*[@id="id_Jac6JQW"]/div/p[31]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[37]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[40]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[47]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[50]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[58]/strong	//*[@id="id_Jac6JQW"]/div/p[61]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[68]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[71]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[77]/strong	//*[@id="id_Jac6JQW"]/div/p[80]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[87]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[90]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[96]/strong	//*[@id="id_Jac6JQW"]/div/p[99]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[105]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[114]/strong	//*[@id="id_Jac6JQW"]/div/p[117]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[123]/strong	//*[@id="id_Jac6JQW"]/div/p[126]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[131]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[135]/font/text()
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[139]/strong	//*[@id="id_Jac6JQW"]/div/p[142]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[148]/strong	//*[@id="id_Jac6JQW"]/div/p[151]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[157]/strong	//*[@id="id_Jac6JQW"]/div/p[160]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[166]/strong	//*[@id="id_Jac6JQW"]/div/p[169]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[174]/strong	//*[@id="id_Jac6JQW"]/div/p[177]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[183]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[192]/strong	//*[@id="id_Jac6JQW"]/div/p[195]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[201]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[204]/text()[2]

Continued on next page

Table 27 – continued from previous page

Url	XPath	Master's
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[210]/strong	//*[@id="id_Jac6JQW"]/div/p[213]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[219]/strong	//*[@id="id_Jac6JQW"]/div/p[222]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[229]/strong	//*[@id="id_Jac6JQW"]/div/p[232]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[238]/strong	//*[@id="id_Jac6JQW"]/div/p[241]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[247]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[250]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[256]/strong	//*[@id="id_Jac6JQW"]/div/p[259]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[265]/strong	//*[@id="id_Jac6JQW"]/div/p[268]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[274]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[283]/strong	//*[@id="id_Jac6JQW"]/div/p[286]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[292]/strong	//*[@id="id_Jac6JQW"]/div/p[295]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[292]/strong	//*[@id="id_Jac6JQW"]/div/p[304]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[292]/strong	//*[@id="id_Jac6JQW"]/div/p[305]/text()
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[312]/strong	//*[@id="id_Jac6JQW"]/div/p[315]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[321]/strong	//*[@id="id_Jac6JQW"]/div/p[324]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[331]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[334]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[340]/strong	//*[@id="id_Jac6JQW"]/div/p[343]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[349]/strong	//*[@id="id_Jac6JQW"]/div/p[352]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[358]/strong	//*[@id="id_Jac6JQW"]/div/p[361]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[367]/strong	//*[@id="id_Jac6JQW"]/div/p[370]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[376]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[379]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[385]/strong	//*[@id="id_Jac6JQW"]/div/p[388]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[394]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[397]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[403]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[406]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[413]/strong	//*[@id="id_Jac6JQW"]/div/p[416]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[422]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[425]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[432]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[441]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[444]/text()[2]

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Table 27 – continued from previous page

Url	XPath	Master's
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[451]/strong	//*[@id="id_Jac6JQW"]/div/p[454]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[461]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[470]/strong	//*[@id="id_Jac6JQW"]/div/p[473]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[479]/strong	//*[@id="id_Jac6JQW"]/div/p[482]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[488]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[491]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[498]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[507]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[510]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[516]/strong	//*[@id="id_Jac6JQW"]/div/p[519]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[525]/strong	//*[@id="id_Jac6JQW"]/div/p[528]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[535]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[538]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[544]/strong	//*[@id="id_Jac6JQW"]/div/p[547]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[553]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[556]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[563]/strong	//*[@id="id_Jac6JQW"]/div/p[566]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[572]/strong	//*[@id="id_Jac6JQW"]/div/p[575]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[581]/strong	//*[@id="id_Jac6JQW"]/div/p[584]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[590]/strong	//*[@id="id_Jac6JQW"]/div/p[593]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[600]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[603]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[609]/strong	//*[@id="id_Jac6JQW"]/div/p[612]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[618]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[621]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[628]/strong	//*[@id="id_Jac6JQW"]/div/p[631]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[638]/strong	//*[@id="id_Jac6JQW"]/div/p[641]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[647]/strong	//*[@id="id_Jac6JQW"]/div/p[650]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[657]/strong	//*[@id="id_Jac6JQW"]/div/p[660]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[666]/strong	//*[@id="id_Jac6JQW"]/div/p[669]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[675]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[684]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[687]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[693]/strong	//*[@id="id_Jac6JQW"]/div/p[696]/text()[2]

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Table 27 – continued from previous page

Url	XPath	Master's
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[703]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[713]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[716]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[723]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[732]/strong	//*[@id="id_Jac6JQW"]/div/p[735]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[742]/strong	//*[@id="id_Jac6JQW"]/div/p[745]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[751]/strong	//*[@id="id_Jac6JQW"]/div/p[754]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[760]/strong	//*[@id="id_Jac6JQW"]/div/p[763]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[770]/strong	//*[@id="id_Jac6JQW"]/div/p[773]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[780]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[783]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[789]/strong	//*[@id="id_Jac6JQW"]/div/p[792]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[798]/strong	//*[@id="id_Jac6JQW"]/div/p[801]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[807]/strong	//*[@id="id_Jac6JQW"]/div/p[810]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[816]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[819]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[826]/strong	//*[@id="id_Jac6JQW"]/div/p[829]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[835]/strong	//*[@id="id_Jac6JQW"]/div/p[838]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[845]/strong	//*[@id="id_Jac6JQW"]/div/p[848]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[854]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[857]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[863]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[866]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[872]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[875]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[881]/strong	//*[@id="id_Jac6JQW"]/div/p[884]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[890]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[893]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[899]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[902]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[908]/strong	//*[@id="id_Jac6JQW"]/div/p[911]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[917]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[927]/strong	//*[@id="id_Jac6JQW"]/div/p[930]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[936]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[945]/strong	//*[@id="id_Jac6JQW"]/div/p[949]/text()

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Table 27 – continued from previous page

Url	XPath	Master's
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[955]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[958]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[964]/strong	//*[@id="id_Jac6JQW"]/div/p[967]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[974]/strong	//*[@id="id_Jac6JQW"]/div/p[977]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[984]/strong	//*[@id="id_Jac6JQW"]/div/p[987]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[993]/strong	//*[@id="id_Jac6JQW"]/div/p[996]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1002]/strong	//*[@id="id_Jac6JQW"]/div/p[1005]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1002]/strong	//*[@id="id_Jac6JQW"]/div/p[1006]/text()
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1012]/strong	//*[@id="id_Jac6JQW"]/div/p[1015]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1021]/strong	//*[@id="id_Jac6JQW"]/div/p[1024]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1030]/strong	//*[@id="id_Jac6JQW"]/div/p[1033]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1040]/strong	//*[@id="id_Jac6JQW"]/div/p[1043]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1049]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[1052]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1058]/strong/text(	//*[@id="id_Jac6JQW"]/div/p[1061]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1068]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1077]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1086]/strong	//*[@id="id_Jac6JQW"]/div/p[1089]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1095]/strong/text(	//*[@id="id_Jac6JQW"]/div/p[1098]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1105]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[1108]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1115]/strong/text(	//*[@id="id_Jac6JQW"]/div/p[1118]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1124]/strong	//*[@id="id_Jac6JQW"]/div/p[1127]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1133]/strong	//*[@id="id_Jac6JQW"]/div/p[1136]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1142]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1151]/strong	//*[@id="id_Jac6JQW"]/div/p[1154]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1160]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1169]/strong	//*[@id="id_Jac6JQW"]/div/p[1172]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1179]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[1182]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1188]/strong	//*[@id="id_Jac6JQW"]/div/p[1191]/text()[2]

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Table 27 – continued from previous page

Url	XPath	Master's
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1197]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1206]/strong/text(	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1216]/strong	//*[@id="id_Jac6JQW"]/div/p[1219]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1226]/strong	//*[@id="id_Jac6JQW"]/div/p[1229]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1235]/strong	//*[@id="id_Jac6JQW"]/div/p[1238]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1244]/strong	//*[@id="id_Jac6JQW"]/div/p[1247]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1254]/strong	//*[@id="id_Jac6JQW"]/div/p[1257]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1264]/strong	//*[@id="id_Jac6JQW"]/div/p[1267]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1273]/strong	//*[@id="id_Jac6JQW"]/div/p[1276]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1282]/strong	//*[@id="id_Jac6JQW"]/div/p[1285]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1291]/strong	//*[@id="id_Jac6JQW"]/div/p[1294]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1300]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1309]/strong	//*[@id="id_Jac6JQW"]/div/p[1312]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1318]/strong	//*[@id="id_Jac6JQW"]/div/p[1321]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1328]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1337]/strong/text(	//*[@id="id_Jac6JQW"]/div/p[1340]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1346]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1355]/strong	//*[@id="id_Jac6JQW"]/div/p[1358]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1364]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1373]/strong	//*[@id="id_Jac6JQW"]/div/p[1376]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1382]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[1385]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1391]/strong	//*[@id="id_Jac6JQW"]/div/p[1394]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1400]/strong	//*[@id="id_Jac6JQW"]/div/p[1403]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1410]/strong	//*[@id="id_Jac6JQW"]/div/p[1413]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1419]/strong	//*[@id="id_Jac6JQW"]/div/p[1422]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1428]/strong	//*[@id="id_Jac6JQW"]/div/p[1431]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1437]/strong	//*[@id="id_Jac6JQW"]/div/p[1440]/text()[3]

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Table 27 – continued from previous page

Url	XPath	Master's
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1446]/strong	//*[@id="id_Jac6JQW"]/div/p[1449]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1455]/strong	//*[@id="id_Jac6JQW"]/div/p[1458]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1464]/strong	//*[@id="id_Jac6JQW"]/div/p[1467]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1473]/strong	//*[@id="id_Jac6JQW"]/div/p[1476]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1482]/strong	//*[@id="id_Jac6JQW"]/div/p[1485]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1491]/strong	//*[@id="id_Jac6JQW"]/div/p[1494]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1500]/strong	//*[@id="id_Jac6JQW"]/div/p[1503]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1509]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[1512]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1518]/strong	//*[@id="id_Jac6JQW"]/div/p[1521]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1527]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1537]/strong/text(	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1546]/strong	//*[@id="id_Jac6JQW"]/div/p[1549]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1555]/strong/text(	//*[@id="id_Jac6JQW"]/div/p[1558]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1564]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[1567]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1573]/strong/text(	//*[@id="id_Jac6JQW"]/div/p[1576]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1583]/strong	//*[@id="id_Jac6JQW"]/div/p[1586]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1592]/strong	//*[@id="id_Jac6JQW"]/div/p[1595]/text()[2]

Appendix G

XPath Script for ASEM PhD Tag

Table 28: XPath Script to Extract Data from ASEM (PhD)

Url	XPath	PhD
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[10]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[13]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[19]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[28]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[37]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[47]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[58]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[68]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[77]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[87]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[96]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[105]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[114]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[123]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[131]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[139]/strong	//*[@id="id_Jac6JQW"]/div/p[151]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[148]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[157]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[166]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[174]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[183]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[192]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[201]/strong/text()	

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Table 28 – continued from previous page

Url	XPath	PhD
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[210]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[219]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[229]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[238]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[247]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[256]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[265]/strong	//*[@id="id_Jac6JQW"]/div/p[268]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[274]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[283]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[292]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[292]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[292]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[312]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[321]/strong	//*[@id="id_Jac6JQW"]/div/p[325]/text()
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[331]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[340]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[349]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[358]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[367]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[376]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[385]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[394]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[403]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[407]/text()
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[413]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[422]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[432]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[441]/strong/text()	

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Table 28 – continued from previous page

Url	XPath	PhD
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[451]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[461]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[470]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[479]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[488]/strong/text()	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[498]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[507]/strong/text()	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[516]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[525]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[535]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[544]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[553]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[563]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[572]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[581]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[590]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[600]/strong/text()	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[609]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[618]/strong/text()	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[628]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[638]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[647]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[657]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[666]/strong	//*[@id="id_Jac6JQW"]/div/p[669]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[675]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[684]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[693]/strong	

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Table 28 – continued from previous page

Url	XPath	PhD
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[703]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[713]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[723]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[732]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[742]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[751]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[760]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[770]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[780]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[789]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[798]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[807]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[816]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[820]/text()
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[826]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[835]/strong	//*[@id="id_Jac6JQW"]/div/p[839]/text()
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[845]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[854]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[863]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[872]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[881]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[890]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[899]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[908]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[917]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[927]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[936]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[945]/strong	

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Table 28 – continued from previous page

Url	XPath	PhD
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[955]/strong/text()	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[964]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[974]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[984]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[993]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1002]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1002]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1012]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1021]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1030]/strong	//*[@id="id_Jac6JQW"]/div/p[1034]/text()
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1040]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1049]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1058]/strong/text(	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1068]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1077]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1086]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1095]/strong/text(	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1105]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[1109]/text()
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1115]/strong/text(	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1124]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1133]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1142]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1151]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1160]/strong	//*[@id="id_Jac6JQW"]/div/p[1163]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1169]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1179]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1188]/strong	//*[@id="id_Jac6JQW"]/div/p[1191]/text()[3]

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Table 28 – continued from previous page

Url	XPath	PhD
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1197]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1206]/strong/text(	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1216]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1226]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1235]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1244]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1254]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1264]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1273]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1282]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1291]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1300]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1309]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1318]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1328]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1337]/strong/text(	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1346]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1355]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1364]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1373]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1382]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1391]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1400]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1410]/strong	//*[@id="id_Jac6JQW"]/div/p[1413]/text()[3]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1419]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1428]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1437]/strong	

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Table 28 – continued from previous page

Url	XPath	PhD
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1446]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1455]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1464]/strong	//*[@id="id_Jac6JQW"]/div/p[1467]/text()[3]
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1473]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1482]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1491]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1500]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1509]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[1512]/text()[3]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1518]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1527]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1537]/strong/text(	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1546]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1555]/strong/text(	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1564]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1573]/strong/text(	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1583]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1592]/strong	

Appendix H

XPath Script for ASEM Bachelor's Tag

Table 29: XPath Script to Extract Data from ASEM (Bachelor's)

Url	XPath	Bachelor's
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1]/strong/text()	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[10]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[19]/strong/text()	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[28]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[37]/strong/text()	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[47]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[58]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[68]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[77]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[87]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[96]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[105]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[108]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[114]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[123]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[131]/strong/text()	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[139]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[148]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[157]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[166]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[174]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[183]/strong	//*[@id="id_Jac6JQW"]/div/p[186]/text()[2]
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[192]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[201]/strong/text()	

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Table 29 – continued from previous page

Url	XPath	Bachelor's
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[210]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[219]/strong	//*[@id="id_Jac6JQW"]/div/p[222]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[229]/strong	
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Table 29 – continued from previous page

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https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[470]/strong	
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https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[507]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[510]/text()[2]
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https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[535]/strong/text()	
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https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[553]/strong/text()	
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https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[581]/strong	
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https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[609]/strong	
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https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[628]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[638]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[647]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[657]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[666]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[675]/strong	//*[@id="id_Jac6JQW"]/div/p[678]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[684]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[693]/strong	

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https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[713]/strong/text()	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[723]/strong	//*[@id="id_Jac6JQW"]/div/p[726]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[732]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[742]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[751]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[760]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[770]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[780]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[789]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[798]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[807]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[816]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[819]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[826]/strong	//*[@id="id_Jac6JQW"]/div/p[829]/text()[2]
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[835]/strong	//*[@id="id_Jac6JQW"]/div/p[838]/text()[2]
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[845]/strong	
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https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1077]/strong	//*[@id="id_Jac6JQW"]/div/p[1080]/text()[2]
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https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1095]/strong/text(	//*[@id="id_Jac6JQW"]/div/p[1098]/text()[2]
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https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1282]/strong	
https://www.asem.org/EM-Program-List	//*[@id="id_Jac6JQW"]/div/p[1291]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1300]/strong	//*[@id="id_Jac6JQW"]/div/p[1303]/text()[2]
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https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1473]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1482]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1491]/strong	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1500]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1509]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1518]/strong	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1527]/strong/text()	//*[@id="id_Jac6JQW"]/div/p[1530]/text()[2]
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https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1555]/strong/text(	
https://www.asem.org/EM- Program-List	//*[@id="id_Jac6JQW"]/div/p[1564]/strong/text()	
https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1573]/strong/text(	
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https://www.asem.org/EM Program-List	//*[@id="id_Jac6JQW"]/div/p[1592]/strong	

Appendix I

Universitas 21 EM-List: Degrees

Table 30: Universitas 21 EM-List: Degrees

University	Master's Course	PhD Course	Bachelor's Course
University of Melbourne	Master of Engineering Management		
University of Queensland	MEngSc: Management	PhD : Management	
UNSW Australia	MEng Sc: Manufacturing Engineering and Management		
University of British Columbia	Master of Engineering Leadership		
McGill University			BEng: Construction Engineering and Management
Pontificia Universidad Catlica de Chile	Masters Degree in Industrial Engineering		
Fudan University			
University of Hong Kong	MSc(Eng) (Industrial Engineering and Logistics Management)		
University of Delhi	M.TECH. Engineering Management		
University College Dublin	Master of Engineering Management		
Waseda University	Masters Industrial and Management Systems Engineering		
Tecnolgico de Monterrey	Master in Engineering Management		
University of Auckland	Master of Engineering Management		
National University of Singapore	Master of Science (Management of Technology)		
University of Johannesburg	MEng/MPhil: Engineering Management	DEng/DPhil: Engineering Management	
Korea University	M.S. : Management Engineering		
Lund University	MSc with a major in Management		
University of Amsterdam			
University of Birmingham	Advanced Engineering Management MSc		
University of Edinburgh	MSc in Management		
University of Glasgow	Masters in Mechanical Engineering and Management		
University of Nottingham	MSc Manufacturing Engineering and Management		
University of Connecticut			BS: Management & Engineering for Manufacturing
University of Maryland	MEng in Project Management Program		

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Table 30 – continued from previous page

University	Master's Course	PhD Course	Bachelor's Course
The Ohio State University	Master of Global Engineering Leadership		
25	**21**	**2**	**2**

Appendix J

Universitas 21 EM-List: Delivery Method

Table 31: Universitas 21 EM-List: Delivery Method

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
University of Melbourne	Yes	Yes	No	Yes	
University of Queensland	Yes	Yes	No	Yes	
UNSW Australia					
University of British Columbia	Yes				
McGill University	Yes				
Pontificia Universidad Catlica de Chile		Yes		Yes	
Fudan University					
University of Hong Kong	Yes	Yes		Yes	Yes
University of Delhi	Yes			Yes	Yes
University College Dublin		Yes		Yes	Yes
Waseda University				Yes	
Tecnolgico de Monterrey		Yes	Yes	Yes	Yes
University of Auckland	Yes	Yes	Yes	Yes	Yes
National University of Singapore		Yes			
University of Johannesburg	Yes	Yes	Yes	Yes	Yes
Korea University					
Lund University					
University of Amsterdam					
University of Birmingham	Yes	Yes	Yes	Yes	Yes
University of Edinburgh				Yes	Yes
University of Glasgow					Yes
University of Nottingham	Yes			Yes	
University of Connecticut	Yes	Yes			
University of Maryland					
The Ohio State University					
25	**11**	**11**	**4**	**13**	**9**

Appendix K

Universitas 21 EM-List: Subject

Table 32: Universitas 21 EM-List: Subject

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
University of Melbourne	Yes	Yes	Yes	Yes	No	Yes
University of Queensland	Yes	Yes	Yes	Yes	Yes	Yes
UNSW Australia	Yes	Yes	Yes	Yes	No	Yes
University of British Columbia	Yes			Yes		Yes
McGill University	Yes		Yes	Yes		
Pontificia Universidad Catlica de Chile		Yes	Yea	Yes	Yes	
Fudan University						
University of Hong Kong	Yes	Yes	Yes	Yes	Yes	
University of Delhi	Yes	Yes	Yes	Yes	Yes	Yes
University College Dublin	Yes	Yes	Yes	Yes	Yes	Yes
Waseda University	Yes	Yes	Yes	Yes	Yes	Yes
Tecnolgico de Monterrey	Yes	Yes	Yes	Yes		
University of Auckland	Yes		Yes	Yes	Yes	
National University of Singapore	Yes	Yes	Yes	Yes		
University of Johannesburg	Yes	Yes	Yes	Yes	Yes	Yes
Korea University	Yes	Yes	Yes	Yes	Yes	Yes
Lund University	Yes			Yes	Yes	
University of Amsterdam						
University of Birmingham	Yes	Yes	Yes	Yes	Yes	Yes
University of Edinburgh	Yes	Yes	Yes	Yes	Yes	Yes
University of Glasgow	Yes			Yes		
University of Nottingham	Yes			Yes		
University of Connecticut	Yes		Yes	Yes	Yes	
University of Maryland	Yes	Yes	Yes	Yes		

Continued on next page

Table 32 – continued from previous page

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
The Ohio State University	**Yes**	**Yes**	**Yes**	Yes		
25	**22**	**16**	**18**	**23**	**13**	**11**

Appendix L

ASEM (Non-American) EM-List: Degrees

Table 33: ASEM (Non-American) EM-List: Degrees

University	Master's Course	PhD Course	Bachelors Course
Institut fur Managementwissenschaften	MSc Engineering Management		
Universiteit Gent	Master of Science in Industrial Engineering and Operations Research		
Univ. of Split Center for Industrial Production	Masters program in Management in the Building Industry		
Helsinki University of Technology	Master's Programme in Industrial Engineering and Management		
Tanpere University of Technology	MSc,Industrial Engineering and Management		
Ecole des Mines de Saint-Etienne	MSc Industrial Engineering and Operations Research (IEOR)		
Institut National Polytechnique de Grenoble	Master Industrial Engineering (GI) Sustainable Industrial		
Chemnitz University of Technology	M.Sc.Systems Engineering		
Institut fur Fabrilbetriebslehre und Unternehmensforschung	Master's degree course in Industrial Engineering		
Ruhr Universitat Bochum	Masters in Sales Engineering and Product Management		
Technische Universitat-Dortmund	Master of Engineering Management		
University of Bremen	Masters Systems Engineering		
National Technical University of Athens	Energy Production and Management		
Fraunhofer Projektkzpont a SZTAKI-ban			
Politecnico di Bari			
Politecnico di Milano			
University of Bologna			
Ss Cyril and Methodius University in Skopje			
Norwegian University of Science and Technology	Master of Science (MSc) in Global Manufacturing Management	PhD Program in Production and Quality Engineering	
Politechnika Warszawska	Management and Production Engineering		
Poznan University of Technology			

Continued on next page

Table 33 – continued from previous page

University	Master's Course	PhD Course	Bachelors Course
Wroclaw University of Technology			
Instituto Politecnico	Masters Global Production Engineering and Management	PhD Production Management, Technology Transfer, Productivity, Technological Innovation	
St. Petersburg Institute			
University of Johannesburg	MEng/MPhil: Engineering Management	DEng/DPhil: Engineering Management	
Centro Politecnico Superior de Ingenieros	Master in Engineering Management.		
Polytechnics of Madrid	Master in Engineering Management.	PhD in Engineering Management	
Universidad de Valladolid	Masters Industrial Engineering		
Linkoping Institute of Technology	Masters Industrial Engineering and Management		
Aston University	MSc Engineering Management		
Total: 31	**22**	**4**	**0**

Appendix M

ASEM (Non-American) EM-List: Delivery Method

Table 34: ASEM (Non-American) EM-List: Delivery Method

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
Institut fur Managementwissenschaften					Yes
Universiteit Gent					Yes
Univ. of Split					
Center for Industrial Production	Yes				Yes
Helsinki University of Technology					Yes
Tanpere University of Technology	Yes				Yes
Ecole des Mines de Saint-Etienne					Yes
Institut National Polytechnique de Grenoble					Yes
Chemnitz University of Technology					
Institut fur Fabrilbetriebslehre und Unternehmensforschung					Yes
Ruhr Universitat Bochum					
Technische Universitat-Dortmund					
University of Bremen					Yes
National Technical University of Athens					
Fraunhofer Projektkzpont a SZTAKI-ban					Yes
Politecnico di Bari					
Politecnico di Milano					
University of Bologna					
Ss Cyril and Methodius University in Skopje					
Norwegian University of Science and Technology					
Politechnika Warszawska					
Poznan University of Technology					
Wroclaw University of Technology					
Instituto Politecnico	Yes				
St. Petersburg Institute					
University of Johannesburg	Yes	Yes	Yes	Yes	Yes

Continued on next page

Table 34 – continued from previous page

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
Centro Politecnico Superior de Ingenieros Polytechnics of Madrid					Yes
Universidad de Valladolid	Yes			Yes	Yes
Linkoping Institute of Technology	Yes	Yes		Yes	
Aston University	Yes	Yes		Yes	Yes
31	**7**	**3**	**1**	**4**	**14**

Appendix N

ASEM (Non-American) EM-List: Subject

Table 35: ASEM (Non-American) EM-List: Subject

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
Institut fur Managementwissenschaften	Yes	Yes	Yes	Yes	Yes	Yes
Universiteit Gent	Yes	Yes	Yes	Yes	Yes	Yes
Univ. of Split Center for Industrial Production	Yes	Yes		Yes	Yes	Yes
Helsinki University of Technology	Yes		Yes	Yes	Yes	
Tanpere University of Technology	Yes	Yes		Yes	Yes	Yes
Ecole des Mines de Saint-Etienne	Yes	Yes			Yes	Yes
Institut National Polytechnique de Grenoble	Yes	Yes	Yes	Yes	Yes	Yes
Chemnitz University of Technology Institut fur Fabrilbetriebslehre und Unternehmensforschung		Yes				Yes
Ruhr Universitat Bochum	Yes	Yes		Yes	Yes	Yes
Technische Universitat-Dortmund			Yes	Yes		
University of Bremen	Yes					
National Technical University of Athens	Yes	Yes		Yes		Yes
Fraunhofer Projektkzpont a SZTAKI-ban						
Politecnico di Bari		Yes	Yes	Yes	Yes	
Politecnico di Milano	Yes		Yes	Yes	Yes	Yes

Continued on next page

Table 35 – continued from previous page

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
University of Bologna						
Ss Cyril and Methodius University in Skopje				Yes	Yes	
Norwegian University of Science and Technology	Yes	Yes	Yes	Yes		
Politechnika Warszawska		Yes	Yes	Yes	Yes	Yes
Poznan University of Technology						
Wroclaw University of Technology						
Instituto Politecnico						
St. Petersburg Institute						
University of Johannesburg	Yes	Yes	Yes	Yes	Yes	Yes
Centro Politecnico Superior de Ingenieros	Yes	Yes				Yes
Polytechnics of Madrid				Yes		
Universidad de Valladolid	Yes	Yes				
Linkoping Institute of Technology	Yes	Yes		Yes	Yes	Yes
Aston University	Yes	Yes	Yes	Yes	Yes	Yes
31	**17**	**17**	**11**	**18**	**15**	**15**

Appendix O

ASEM EM-List: Degrees

Table 36: ASEM EM-List: Degrees

University	Master's Course	PhD Course	Bachelor's Course
University of Alabama - Birmingham	MS, Engineering Management		
University of Alabama - Huntsville	MSE, Engineering Management	PhD, Engineering Management	
University of Alaska - Anchorage	MS, Science and Engineering Management		
University of Alaska - Fairbanks	MS, Construction Management		
Arizona State University	MS Tech, Management of Technology		
Northern Arizona University	MS, Project Management		
University of Arizona	MS, Engineering Management		
Arkansas State University	MS, Engineering Management		
University of Arkansas	MSE, Engineering Management		
California State Polytechnic University - Pomona	MS, Engineering Management		
California State University - East Bay	MS, Engineering Management		
California State University - Long Beach			BS, Construction Engineering Management
California State University - Northridge	MS, Engineering Management		
National University	MSE, Engineering Management		
Northcentral University	MBA, Specialty in Business and Technology Management		
Santa Clara University	MS, Engineering Management and Leadership	PhD, Management and Science Engineering	
Stanford University	MS, Technology and Engineering Management		
University of California - Los Angeles	MS, Engineering Management		
University of California - Riverside			PGDEM, Engineering Management
University of Southern California	MS, Engineering Management		
University of the Pacific			BSEM, Engineering Management
University of California, Irvine	MS, Engineering Management		
Colorado School of Mines	MS, Engineering and Technology Management		
Colorado State University	MM, Engineering Management Specialization		
University of Colorado - Boulder	MSE, Engineering Management		BSEM, Engineering Management
University of Colorado - Colorado Springs	MS, Engineering Management		
University of Denver	MS, Technology Management		

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Table 36 – continued from previous page

University	Master's Course	PhD Course	Bachelor's Course
Central Connecticut State University	MS, Technology Management		
Fairfield University	MSE, Engineering Management		BSEM, Engineering Management
University of Bridgeport	MS, Technology Management	PhD, Technology Management	
University of Connecticut			BSEM, Management and Engineering for Manufacturing
University of Hartford	MS, Engineering and Management		
University of New Haven	MS, Engineering Management		
Catholic University of America	MS, Engineering Management and Organization		
Georgetown University	MSE, Engineering Management		BSEM, Engineering Management
George Washington University	MSE, Engineering Management	PhD, Engineering Management	BSEM, Engineering Management
Florida A& M University / Florida State University (FAMU-FSU)	MS, Industrial Engineering with Engineering Management Specialization		
Florida Institute of Technology	MSE, Engineering Management		
Florida International University	MSE, Engineering Management		
University of Central Florida	MS, Engineering Management		
University of South Florida	MS, Engineering Management		
Georgia Tech	MS, Systems Engineering, PMASE		
Mercer University	MSE, Engineering Management		
University of Idaho	MS, Masters in Engineering		
Northwestern University	MSE, Engineering Management	PhD, Engineering Management	BSEM, Engineering Management
Southern Illinois University	MS, Engineering and Management		
University of Illinois at Urbana-Champaign	MS, Systems and Entrepreneurial Engineering		BS, Systems Engineering and Design
University of Illinois - Chicago			BS, Engineering Management
Indiana Institute of Technology	MSE, Engineering Management		
Indiana State University	MS, Technology Management		
Purdue University	MS Graduate Degree Program		
Rose-Hulman Institute of Technology	MSE, Engineering Management		
Trine University	MS, Engineering Management		
Valparasio University	MSE, Engineering Management		
Iowa State University - Ames			BS, Engineering Management
Kansas State University	MS, Engineering Management		BS, Engineering Management
University of Kansas	MS, Engineering Management		
Wichita State University	MSE, Engineering Management		
University of Louisville	MS, Engineering Management		
Western Kentucky University	MSE, Engineering Management		
Louisiana Tech University	MEM, Engineering Management		
McNeese State University	MEE, Engineering Management		
Southern University and A& M College	MS, Engineering Management		
University of New Orleans	MS, Engineering Management		
University of Southwestern Louisiana	MS, Engineering Management		
John Hopkins University	MEM, Engineering Management		

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Table 36 – continued from previous page

University	Master's Course	PhD Course	Bachelor's Course
University of Maryland - Baltimore County	MS, Engineering Management		
Merrimack College	MSE, Engineering Management		
Northeastern University	MSE, Engineering Management		
Tufts University	MS, Engineering Management		
University of Massachusetts - Amherst	MS, Engineering Management		
University of Massachusetts-Lowell	MS, Engineering Management		
Western New England University	MSE, Engineering Management	PhD, Engineering Management	
Worcester Polytechnic Institute	MSE, Engineering Management		BSEM, Engineering Management
Eastern Michigan University	EGMT, Engineering Management		
Kattering University	MS, Engineering Management		
Lake Superior State University			BSEM, Engineering Management
Lawrence Technological University	MSE, Engineering Management		
Michigan Technological University			BSEM, Engineering Management
Oakland University	MS, Engineering Management		
University of Detroit - Mercy	MEM, Engineering Management		
University of MichiganDearborn	MS, Engineering Management		
Wayne State University	MSE, Engineering Management		
Western Michigan University	MSE, Engineering Management		
Saint Cloud State University	MEM, Engineering Management		
University of Minnesota - Duluth	MS, Engineering Management		
University of Minnesota	MS, Engineering Management		
University of Saint Thomas	MS, Technology Management		
Missouri University of Science & Technology	MSE, Engineering Management	PhD, Engineering Management	BSEM, Engineering Management
Southeast Missouri State University	MSTM, Technology Management		BS, Technology Management
University of Central Missouri	MS, Industrial Management	PhD, Technology Management	BS, Technology Management
Washington University - St. Louis	MEM, Engineering Management		
Montana State University	MS, Industrial and Management Engineering		BS, Industrial & Management Systems Engineering
Montana Tech	MPEM, Project Engineering & Management		
University of Nebraska - Lincoln	MEM, Engineering Management		
Dartmouth College	MEM, Engineering Management		
New Jersey Institute of Technology	MS, Engineering Management		
Rowan University	MS, Engineering Management		
The College of New Jersey			BS, Engineering Management
New Mexico Institute of Mining and Technology (New Mexico Tech)	MS, Engineering Management		
Clarkson University			BS, Engineering and Management
Columbia University	MS, Management Science and Engineering		BS, Engineering Management Systems

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Table 36 – continued from previous page

University	Master's Course	PhD Course	Bachelor's Course
Cornell University	MS, Engineering Management		
Hofstra University	MS, Engineering Management		
Long Island University	MS, Engineering Management		
New York Institute of Technology			BS, Engineering Management
New York University	MS, Engineering Management		BS, Engineering Management
Rensselaer Polytechnic Institute	MSE, Industrial & Management Engineering Program & MS, Systems Engineering & Technology Management (SETM)		BSIME, Industrial & Management Engineering
Rochester Institute of Technology	MS, Engineering Management		
State University of New York - Stony Brook	MSE, Systems Management		
Stevens Institute of Technology	MSE, Engineering Management	PhD, Engineering Management	BS, Engineering Management
Syracuse University	MS, Engineering Management		
United States Military Academy at West Point	MS, Engineering Management		BSEM, Engineering Management
Duke University	MEM, Engineering Management		
East Carolina University			BSEM, Engineering Management
North Carolina A& T State University			BSEM, Industrial and Systems Engineering
University of North Carolina - Charlotte	MS, Systems Engineering & Engineering Management		
North Dakota State University	MS, Industrial Engineering and Management		BSIEM, Industrial Engineering and Management
Oklahoma State University	MSE, Engineering Management	PhD, Engineering Management	BS, Engineering Management
Air Force Institute of Technology	MS, Engineering Management		
Case Western Reserve University	MEM, Engineering and Management Degree		
Miami University			BS, Engineering Management
Ohio University			BS, Technical Operations Management
University of Akron	MS, Engineering Management		
Bowling Green State University		PhD, Technology Management	
University of Dayton	ENM, Engineering Management		
Oregon State University	MSE, Engineering Management		
Portland State University	MS, Engineering and Technology Management	PhD, Technology Management	
University of Portland			BSEM, Engineering Management
Bucknell University			BS, Bachelor of Management for Engineers
Carnegie Mellon University	MS, Engineering and Technology Innovation Management (E& TIM)		
Drexel University	MS, Engineering Management		
Gannon University	MSE, Engineering Management		
Lehigh University	MS, Management Science and Engineering		
Pennsylvania State University - Harrisburg	MS, Engineering Management		
Pennsylvania State University - University Park	MS, Engineering Leadership Management		

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Table 36 – continued from previous page

University	Master's Course	PhD Course	Bachelor's Course
Point Park University	MS, Engineering Management		
Robert Morris University	MS, Engineering Management		
Temple University	MS, Engineering Management		
University of Pennsylvania	Executive Master's in Technology Management		BSE, Management & Technology
Widener University	MS, Engineering Management		
Wilkes University	MS, Engineering Management		BS, Engineering Management
York College			BSEM, Engineering Management
Polytechnic University of Puerto Rico	MEM, Engineering Management		
The Citadel Military College of South Carolina	Master of Science in Project Management		BS, Project Management / Certificate Systems Engineering Management
University of South Carolina - Upstate	MS, Engineering Management		
Augustana College			BA/BS, Engineering Management
South Dakota School of Mines & Technology	MS, Engineering Management		BS, Industrial Engineering & Engineering Management
Christian Brothers University	MS, Engineering Management		BS, Engineering Management
Lipscomb University	MSE, Engineering Management		
University of Tennessee - Chattanooga	MS, Engineering Management		BSEM, Engineering Management
University of Tennessee Space Institute	MSE, Engineering Management	PhD, Engineering Management	
Lamar University	MEM, Engineering Management		
LeTourneau University	MEM, Engineering Management		
Saint Mary's University	MSE, Engineering Systems Management		BS, Engineering Management
Southern Methodist University	MS, Engineering Management		
Texas A & M University - College Station	MS, Engineering Systems Management		
Texas Tech University	MS, Systems and Engineering Management	PhD, Engineering Management	
University of Houston	Master's Degree Program in Industrial Engineering (MIE)		
University of Texas - Arlington	MS, Engineering Management		
University of Texas - Austin	MSE, Engineering Management		
University of Texas-Pan American	MS, Engineering Management		
Old Dominion University	MEM, Engineering Management	PhD, Engineering Management & Systems Engineering	
Virginia Tech (Virginia Polytechnic and State University)	MS, Engineering Management		
University of Vermont			BSEM, Engineering Management
Gonzaga University			BSEM, Engineering Management
Saint Martins College	MEM, Engineering Management		BSEM, Engineering Management
Washington State University	MSE, Engineering Management		
Marshall University	MSE, Engineering Management		

Continued on next page

Table 36 – continued from previous page

University	Master's Course	PhD Course	Bachelor's Course
Marquette University	MS, Engineering Management		
Milwaukee School of Engineering	MSE, Engineering Management		
University of Wisconsin - Madison	MSE, Engineering Management		
172	**151**	**15**	**47**

Appendix P

ASEM EM-List: Delivery Method

Table 37: ASEM EM-List: Delivery Method

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
University of Alabama - Birmingham			Yes	Yes	
University of Alabama - Huntsville					Yes
University of Alaska - Anchorage					Yes
University of Alaska - Fairbanks				Yes	
Arizona State University		Yes			Yes
Northern Arizona University			Yes		Yes
University of Arizona			Yes	Yes	Yes
Arkansas State University		Yes	Yes	Yes	
University of Arkansas			Yes		
California State Polytechnic University - Pomona		Yes		Yes	Yes
California State University - East Bay					Yes
California State University - Long Beach	Yes			Yes	
California State University - Northridge		Yes	Yes		
National University			Yes		Yes
Northcentral University			Yes		Yes
Santa Clara University		Yes	Yes		
Stanford University	Yes			Yes	
University of California - Los Angeles		Yes	Yes	Yes	
University of California - Riverside	Yes				
University of Southern California			Yes	Yes	
University of the Pacific	Yes			Yes	
University of California, Irvine					
Colorado School of Mines	Yes			Yes	Yes
Colorado State University	Yes		Yes	Yes	
University of Colorado - Boulder	Yes		Yes	Yes	Yes
University of Colorado - Colorado Springs	Yes		Yes		Yes
University of Denver	Yes		Yes	Yes	Yes
Central Connecticut State University			Yes		
Fairfield University	Yes	Yes		Yes	Yes

Continued on next page

Table 37 – continued from previous page

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
University of Bridgeport		Yes	Yes		Yes
University of Connecticut	Yes			Yes	
University of Hartford	Yes	Yes		Yes	
University of New Haven		Yes		Yes	Yes
Catholic University of America		Yes	Yes		
Georgetown University		Yes	Yes		Yes
George Washington University			Yes		Yes
Florida A& M University / Florida State University (FAMU-FSU)					Yes
Florida Institute of Technology		Yes		Yes	Yes
Florida International University		Yes	Yes	Yes	Yes
University of Central Florida	Yes	Yes	Yes	Yes	Yes
University of South Florida		Yes	Yes	Yes	
Georgia Tech		Yes	Yes	Yes	
Mercer University		Yes		Yes	Yes
University of Idaho		Yes	Yes		Yes
Northwestern University	Yes	Yes		Yes	
Southern Illinois University			Yes		Yes
University of Illinois at Urbana-Champaign					Yes
University of Illinois - Chicago	Yes			Yes	
Indiana Institute of Technology			Yes		
Indiana State University			Yes		
Purdue University			Yes	Yes	
Rose-Hulman Institute of Technology	Yes	Yes		Yes	
Trine University			Yes	Yes	
Valparasio University					
Iowa State University - Ames					
Kansas State University		Yes	Yes		
University of Kansas		Yes	Yes		Yes
Wichita State University			Yes		
University of Louisville		Yes	Yes		
Western Kentucky University			Yes	Yes	
Louisiana Tech University			Yes		
McNeese State University	Yes				
Southern University and A& M College					Yes
University of New Orleans			Yes		Yes
University of Southwestern Louisiana					Yes
John Hopkins University			Yes	Yes	
University of Maryland - Baltimore County		Yes			
Merrimack College					

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Table 37 – continued from previous page

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
Northeastern University	Yes	Yes		Yes	
Tufts University		Yes			Yes
University of Massachusetts - Amherst	Yes	Yes	Yes	Yes	
University of Massachusetts-Lowell	Yes	Yes	Yes	Yes	Yes
Western New England University			Yes	Yes	
Worcester Polytechnic Institute					
Eastern Michigan University			Yes		Yes
Kattering University			Yes		Yes
Lake Superior State University	Yes			Yes	
Lawrence Technological University		Yes	Yes		
Michigan Technological University	Yes			Yes	
Oakland University			Yes	Yes	
University of Detroit - Mercy					
University of MichiganDearborn			Yes	Yes	
Wayne State University			Yes		Yes
Western Michigan University					Yes
Saint Cloud State University			Yes		Yes
University of Minnesota - Duluth			Yes	Yes	
University of Minnesota		Yes		Yes	Yes
University of Saint Thomas					Yes
Missouri University of Science & Technology					Yes
Southeast Missouri State University			Yes		Yes
University of Central Missouri		Yes	Yes	Yes	Yes
Washington University - St. Louis		Yes			
Montana State University					Yes
Montana Tech			Yes		
University of Nebraska - Lincoln		Yes	Yes	Yes	
Dartmouth College		Yes			
New Jersey Institute of Technology		Yes	Yes	Yes	Yes
Rowan University			Yes	Yes	Yes
The College of New Jersey	Yes			Yes	
New Mexico Institute of Mining and Technology (New Mexico Tech)	Yes	Yes	Yes	Yes	
Clarkson University	Yes			Yes	
Columbia University	Yes			Yes	
Cornell University				Yes	Yes
Hofstra University		Yes			Yes

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Table 37 – continued from previous page

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
Long Island University		Yes		Yes	Yes
New York Institute of Technology	Yes			Yes	
New York University		Yes		Yes	Yes
Rensselaer Polytechnic Institute		Yes			Yes
Rochester Institute of Technology					
State University of New York - Stony Brook	Yes	Yes		Yes	Yes
Stevens Institute of Technology	Yes		Yes	Yes	
Syracuse University		Yes		Yes	
United States Military Academy at West Point					
Duke University	Yes	Yes	Yes	Yes	Yes
East Carolina University				Yes	
North Carolina A& T State University	Yes			Yes	
University of North Carolina - Charlotte		Yes	Yes	Yes	Yes
North Dakota State University		Yes	Yes		Yes
Oklahoma State University		Yes	Yes		
Air Force Institute of Technology	Yes	Yes		Yes	Yes
Case Western Reserve University		Yes			
Miami University	Yes			Yes	
Ohio University	Yes			Yes	
Bucknell University	Yes			Yes	
Carnegie Mellon University					
Drexel University					
Gannon University					
Lehigh University		Yes			
Pennsylvania State University - Harrisburg					
Pennsylvania State University - University Park					Yes
Point Park University		Yes			
Robert Morris University			Yes		
Temple University	Yes	Yes	Yes	Yes	
University of Pennsylvania					
Widener University		Yes			Yes
Wilkes University		Yes		Yes	Yes
York College	Yes			Yes	
Polytechnic University of Puerto Rico		Yes	Yes	Yes	
The Citadel Military College of South Carolina				Yes	
University of South Carolina - Upstate		Yes			Yes
Augustana College				Yes	

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Table 37 – continued from previous page

University	Full-Time	Part-Time	Online	Campus	Dissertation Option
South Dakota School of Mines& Technology		Yes		Yes	
Christian Brothers University			Yes	Yes	Yes
Lipscomb University	Yes	Yes		Yes	Yes
University of Tennessee - Chattanooga		Yes		Yes	
University of Tennessee Space Institute		Yes	Yes	Yes	Yes
Lamar University			Yes	Yes	
LeTourneau University			Yes		
Saint Mary's University					
Southern Methodist University					
Texas A & M University - College Station	Yes	Yes	Yes	Yes	Yes
Texas Tech University	Yes	Yes		Yes	Yes
University of Houston				Yes	Yes
University of Texas - Arlington		Yes		Yes	
University of Texas - Austin		Yes	Yes	Yes	Yes
University of Texas-Pan American					Yes
Old Dominion University			Yes	Yes	Yes
Virginia Tech (Virginia Polytechnic and State University)					Yes
University of Vermont	Yes			Yes	Yes
Gonzaga University	Yes			Yes	
Saint Martins College		Yes		Yes	Yes
Washington State University			Yes	Yes	
Marshall University		Yes	Yes	Yes	Yes
Marquette University					Yes
Milwaukee School of Engineering		Yes	Yes		Yes
University of Wisconsin - Madison	Yes		Yes	Yes	
172	**43**	**71**	**77**	**92**	**77**

Appendix Q

ASEM EM-List: Subjects

Table 38: ASEM EM-List: Subjects

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
University of Alabama - Birmingham	Yes		Yes	Yes		
University of Alabama - Huntsville	Yes	Yes	Yes	Yes		Yes
University of Alaska - Anchorage	Yes	Yes	Yes	Yes		Yes
University of Alaska - Fairbanks	Yes	Yes	Yes	Yes	Yes	
Arizona State University	Yes			Yes	Yes	
Northern Arizona University	Yes			Yes		
University of Arizona	Yes	Yes	Yes		Yes	Yes
Arkansas State University			Yes	Yes	Yes	
University of Arkansas	Yes	Yes	Yes	Yes	Yes	Yes
California State Polytechnic University - Pomona	Yes	Yes	Yes	Yes	Yes	Yes
California State University - East Bay	Yes	Yes	Yes	Yes	Yes	Yes
California State University - Long Beach	Yes		Yes	Yes		Yes
California State University - Northridge	Yes	Yes	Yes	Yes	Yes	Yes
National University	Yes	Yes		Yes	Yes	Yes
Northcentral University	Yes	Yes		Yes	Yes	Yes
Santa Clara University	Yes	Yes	Yes	Yes	Yes	Yes
Stanford University	Yes	Yes		Yes	Yes	

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Table 38 – continued from previous page

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
University of California - Los Angeles	Yes	Yes	Yes	Yes		Yes
University of California - Riverside	Yes		Yes	Yes	Yes	
University of Southern California	Yes	Yes	Yes	Yes		Yes
University of the Pacific	Yes	Yes	Yes	Yes		Yes
University of California, Irvine	Yes	Yes	Yes	Yes	Yes	Yes
Colorado School of Mines	Yes	Yes	Yes	Yes	Yes	Yes
Colorado State University	Yes	Yes	Yes	Yes	Yes	Yes
University of Colorado - Boulder	Yes	Yes	Yes	Yes	Yes	Yes
University of Colorado - Colorado Springs	Yes	Yes	Yes	Yes	Yes	
University of Denver	Yes	Yes	Yes	Yes	Yes	
Central Connecticut State University	Yes	Yes	Yes	Yes		Yes
Fairfield University	Yes	Yes	Yes	Yes	Yes	Yes
University of Bridgeport	Yes	Yes	Yes	Yes	Yes	Yes
University of Connecticut	Yes	Yes	Yes	Yes	Yes	
University of Hartford	Yes	Yes	Yes	Yes	Yes	Yes
University of New Haven	Yes	Yes	Yes	Yes	Yes	Yes
Catholic University of America	Yes	Yes	Yes	Yes	Yes	Yes
Georgetown University	Yes	Yes	Yes	Yes	Yes	
George Washington University	Yes	Yes	Yes	Yes		Yes
Florida A& M University / Florida State University (FAMU-FSU)	Yes	Yes	Yes	Yes		Yes
Florida Institute of Technology	Yes			Yes	Yes	Yes

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Table 38 – continued from previous page

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
Florida International University	Yes	Yes	Yes	Yes	Yes	Yes
University of Central Florida	Yes	Yes	Yes	Yes	Yes	Yes
University of South Florida	Yes	Yes	Yes	Yes	Yes	Yes
Georgia Tech	Yes	Yes	Yes	Yes	Yes	Yes
Mercer University	Yes	Yes	Yes	Yes	Yes	Yes
University of Idaho	Yes	Yes	Yes	Yes	Yes	Yes
Northwestern University	Yes	Yes	Yes	Yes	Yes	Yes
Southern Illinois University	Yes			Yes		Yes
University of Illinois at Urbana-Champaign	Yes		Yes	Yes	Yes	Yes
University of Illinois - Chicago	Yes	Yes	Yes	Yes	Yes	Yes
Indiana Institute of Technology	Yes	Yes	Yes	Yes	Yes	Yes
Indiana State University	Yes	Yes	Yes	Yes		Yes
Purdue University	Yes	Yes	Yes	Yes	Yes	Yes
Rose-Hulman Institute of Technology	Yes	Yes	Yes	Yes	Yes	Yes
Trine University	Yes	Yes	Yes	Yes	Yes	Yes
Valparasio University	Yes			Yes	Yes	
Iowa State University - Ames		Yes	Yes	Yes		Yes
Kansas State University	Yes	Yes	Yes	Yes		
University of Kansas	Yes	Yes	Yes	Yes	Yes	Yes
Wichita State University		Yes	Yes	Yes	Yes	Yes
University of Louisville	Yes		Yes	Yes	Yes	Yes
Western Kentucky University	Yes	Yes		Yes	Yes	Yes
Louisiana Tech University	Yes	Yes	Yes	Yes	Yes	Yes
McNeese State University			Yes	Yes	Yes	
Southern University and A& M College	Yes	Yes		Yes	Yes	Yes
University of New Orleans	Yes	Yes		Yes	Yes	Yes

Continued on next page

Table 38 – continued from previous page

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
University of Southwestern Louisiana	Yes	Yes	Yes	Yes	Yes	Yes
John Hopkins University	Yes	Yes	Yes	Yes	Yes	Yes
University of Maryland - Baltimore County	Yes	Yes	Yes	Yes	Yes	
Merrimack College	Yes		Yes	Yes	Yes	
Northeastern University	Yes	Yes	Yes	Yes	Yes	Yes
Tufts University	Yes	Yes	Yes	Yes	Yes	Yes
University of Massachusetts - Amherst	Yes	Yes	Yes	Yes		Yes
University of Massachusetts- Lowell	Yes	Yes	Yes	Yes	Yes	Yes
Western New England University	Yes	Yes	Yes	Yes	Yes	Yes
Worcester Polytechnic Institute			Yes	Yes	Yes	
Eastern Michigan University	Yes	Yes		Yes	Yes	Yes
Kattering University	Yes	Yes	Yes	Yes	Yes	Yes
Lake Superior State University		Yes		Yes		Yes
Lawrence Technological University	Yes	Yes	Yes	Yes	Yes	Yes
Michigan Technological University	Yes	Yes	Yes	Yes	Yes	Yes
Oakland University	Yes	Yes	Yes	Yes	Yes	Yes
University of Detroit - Mercy	Yes	Yes	Yes	Yes	Yes	Yes
University of MichiganDearborn	Yes	Yes	Yes	Yes	Yes	Yes
Wayne State University	Yes	Yes	Yes	Yes	Yes	Yes
Western Michigan University	Yes	Yes	Yes	Yes	Yes	Yes
Saint Cloud State University	Yes	Yes	Yes	Yes	Yes	Yes
University of Minnesota - Duluth	Yes	Yes		Yes		Yes

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Table 38 – continued from previous page

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
University of Minnesota	Yes	Yes	Yes	Yes	Yes	Yes
University of Saint Thomas	Yes	Yes	Yes	Yes		Yes
Missouri University of Science & Technology	Yes	Yes	Yes	Yes	Yes	Yes
Southeast Missouri State University	Yes	Yes	Yes	Yes	Yes	Yes
University of Central Missouri	Yes	Yes	Yes	Yes	Yes	Yes
Washington University - St. Louis	Yes	Yes	Yes	Yes	Yes	Yes
Montana State University	Yes	Yes	Yes	Yes		Yes
Montana Tech	Yes		Yes	Yes		Yes
University of Nebraska - Lincoln	Yes	Yes	Yes	Yes	Yes	Yes
Dartmouth College	Yes	Yes	Yes	Yes	Yes	Yes
New Jersey Institute of Technology	Yes	Yes	Yes	Yes	Yes	Yes
Rowan University	Yes	Yes	Yes	Yes		Yes
The College of New Jersey	Yes		Yes	Yes		
New Mexico Institute of Mining and Technology (New Mexico Tech)	Yes	Yes	Yes	Yes	Yes	
Clarkson University	Yes	Yes	Yes	Yes	Yes	
Columbia University	Yes	Yes	Yes	Yes	Yes	Yes
Cornell University	Yes		Yes	Yes	Yes	Yes
Hofstra University	Yes		Yes		Yes	
Long Island University	Yes		Yes	Yes		Yes
New York Institute of Technology	Yes	Yes	Yes	Yes	Yes	
New York University	Yes	Yes	Yes			
Rensselaer Polytechnic Institute		Yes	Yes			
Rochester Institute of Technology	Yes	Yes	Yes	Yes	Yes	Yes

Continued on next page

Table 38 – continued from previous page

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
State University of New York - Stony Brook	Yes	Yes	Yes	Yes	Yes	Yes
Stevens Institute of Technology	Yes	Yes	Yes	Yes		Yes
Syracuse University	Yes	Yes	Yes	Yes	Yes	Yes
United States Military Academy at West Point	Yes	Yes	Yes	Yes	Yes	Yes
Duke University	Yes	Yes	Yes	Yes	Yes	Yes
East Carolina University		Yes	Yes			
North Carolina A& T State University		Yes	Yes	Yes		Yes
University of North Carolina - Charlotte	Yes	Yes	Yes	Yes	Yes	Yes
North Dakota State University	Yes	Yes	Yes	Yes		Yes
Oklahoma State University	Yes	Yes	Yes	Yes	Yes	Yes
Air Force Institute of Technology	Yes	Yes	Yes	Yes		Yes
Case Western Reserve University	Yes	Yes	Yes	Yes		
Miami University		Yes	Yes	Yes	Yes	
Ohio University			Yes	Yes	Yes	
University of Akron			Yes	Yes	Yes	
Bowling Green State University						
University of Dayton	Yes	Yes	Yes	Yes		Yes
Oregon State University	Yes	Yes	Yes	Yes	Yes	
Portland State University	Yes	Yes	Yes	Yes	Yes	
University of Portland		Yes	Yes	Yes	Yes	
Bucknell University			Yes	Yes	Yes	
Carnegie Mellon University		Yes	Yes	Yes	Yes	
Drexel University	Yes	Yes	Yes	Yes	Yes	Yes
Gannon University	Yes		Yes	Yes	Yes	Yes
Lehigh University			Yes	Yes		
Pennsylvania State University - Harrisburg	Yes		Yes	Yes	Yes	

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Table 38 – continued from previous page

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
Pennsylvania State University - University Park	Yes			Yes	Yes	
Point Park University	Yes	Yes	Yes			
Robert Morris University	Yes	Yes	Yes			
Temple University	Yes		Yes	Yes	Yes	
University of Pennsylvania			Yes	Yes	Yes	
Widener University	Yes			Yes		
Wilkes University	Yes	Yes	Yes	Yes	Yes	
York College	Yes		Yes	Yes	Yes	
Polytechnic University of Puerto Rico	Yes			Yes		
The Citadel Military College of South Carolina	Yes	Yes		Yes		
University of South Carolina - Upstate	Yes		Yes	Yes	Yes	
Augustana College			Yes			Yes
South Dakota School of Mines & Technology	Yes		Yes	Yes		
Christian Brothers University	Yes		Yes	Yes	Yes	
Lipscomb University	Yes	Yes	Yes	Yes		
University of Tennessee - Chattanooga	Yes		Yes	Yes	Yes	Yes
University of Tennessee Space Institute	Yes	Yes	Yes	Yes	Yes	Yes
Lamar University		Yes		Yes		Yes
LeTourneau University	Yes	Yes		Yes		
Saint Mary's University	Yes	Yes	Yes	Yes		
Southern Methodist University		Yes	Yes	Yes		
Texas A & M University - College Station	Yes	Yes	Yes	Yes		Yes
Texas Tech University	Yes	Yes	Yes	Yes		Yes
University of Houston		Yes	Yes			Yes

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Table 38 – continued from previous page

University	Project Management	System Engineering	Engineering Economics	Engineering Management	Product Development and Marketing	Reliability Engineering
University of Texas - Arlington	Yes		Yes	Yes	Yes	Yes
University of Texas - Austin	Yes		Yes	Yes	Yes	
University of Texas-Pan American	Yes	Yes	Yes	Yes		Yes
Old Dominion University	Yes	Yes	Yes	Yes	Yes	Yes
Virginia Tech (Virginia Polytechnic and State University)	Yes	Yes	Yes	Yes		Yes
University of Vermont				Yes		
Gonzaga University		Yes	Yes	Yes	Yes	
Saint Martins College	Yes	Yes				
Washington State University	Yes	Yes	Yes	Yes		Yes
Marshall University	Yes		Yes	Yes		
Marquette University	Yes		Yes	Yes		
Milwaukee School of Engineering		Yes	Yes	Yes	Yes	
University of Wisconsin - Madison	Yes	Yes	Yes	Yes	Yes	
172	**147**	**130**	**149**	**161**	**114**	**110**

Appendix R

Universitas 21 EM-List: Faculty Staff

Table 39: Universitas 21 EM-List: Faculty Staff

University	Masters	PhD	Bachelor	Country	Average Faculty Staff
University of Melbourne	Master of Engineering Management			Australia	
University of Queensland	MEngSc: Management	PhD : Management		Australia	
UNSW Australia	MEng Sc: Manufacturing Engineering and Management			Australia	
University of British Columbia	Master of Engineering Leadership			Canada	
McGill University			BEng: Construction Engineering and Management	Canada	
Pontificia Universidad Catlica de Chile	Masters Degree in Industrial Engineering			Chile	
Fudan University				China with Hong Kong (SAR)	
University of Hong Kong	MSc(Eng) (Industrial Engineering and Logistics Management)			China with Hong Kong (SAR)	
University of Delhi	M.Tech. Engineering Management			India	
University College Dublin	Master of Engineering Management			Ireland	
Waseda University	Masters Industrial and Management Systems Engineering			Japan	
Tecnolgico de Monterrey	Master in Engineering Management			Mexico	
University of Auckland	Master of Engineering Management			New Zealand	

Continued on next page

Table 39 – continued from previous page

University	Masters	PhD	Bachelor	Country	Average Faculty Staff
National University of Singapore	Master of Science (Management of Technology)			Singapore	
University of Johannesburg	MEng/MPhil: Engineering Management	Eng/DPhil: Engineering Management		South Africa	4
Korea University	M.S. : Management Engineering			South Korea	
Lund University	MSc with a major in Management			Sweden	
University of Amsterdam				The Netherlands	
University of Birmingham	Advanced Engineering Management MSc			United Kingdom	
University of Edinburgh	MSc in Management			United Kingdom	
University of Glasgow	Masters in Mechanical Engineering and Management			United Kingdom	
University of Nottingham	MSc Manufacturing Engineering and Management			United Kingdom	
University of Connecticut			BS: Management & Engineering for Manufacturing	United States of America	13
University of Maryland	MEng in Project Management Program			United States of America	
The Ohio State University	Master of Global Engineering Leadership			United States of America	
25	21	2	2		17
Average					8.5

Appendix S

ASEM (Non-American) EM-List: Faculty Staff

Table 40: ASEM (Non-American)EM-List: Faculty Staff

University	Masters	PhD	Bachelor	Country	Average Faculty Staff
Institut fur Managementwissenschaften	MSc Engineering Management			Austria	23
Universiteit Gent	Master of Science in Industrial Engineering and Operations Research			Belguim	
Center for Industrial Production	Masters program in Management in the Building Industry			Denmark	
Helsinki University of Technology	Master's Programme in Industrial Engineering and Management			Finland	
Tanpere University of Technology	MSc,Industrial Engineering and Management			Finland	
Ecole des Mines de Saint-Etienne	MSc Industrial Engineering and Operations Research (IEOR)			France	
Institut National Polytechnique de Grenoble	Master Industrial Engineering (GI) Sustainable Industrial			France	
Chemnitz University of Technology	M.Sc.Systems Engineering			Germany	
Institut fur Fabrilbetriebslehre und Unternehmensforschung	Master's degree course in Industrial Engineering			Germany	
Ruhr Universitat Bochum	Masters in Sales Engineering and Product Management			Germany	
Technische Universitat-Dortmund	Master of Engineering Management			Germany	

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Table 40 – continued from previous page

University	Masters	PhD	Bachelor	Country	Average Faculty Staff
University of Bremen	Masters Systems Engineering			Germany	
National Technical University of Athens	Energy Production and Management			Greece	
Norwegian University of Science and Technology	Master of Science (MSc) in Global Manufacturing Management	PhD Program in Production and Quality Engineering		Norway	
Politechnika Warszawska	Management and Production Engineering			Poland	
Instituto Politecnico	Masters Global Production Engineering and Management	PhD Production Management, Technology Transfer, Productivity, Technological Innovation		Portugal	
University of Johannesburg	MEng/MPhil: Engineering Management	DEng/DPhil: Engineering Management		South Africa	4
Centro Politecnico Superior de Ingenieros	Master in Engineering Management			Spain	
Polytechnics of Madrid	Master in Engineering Management	PhD in Engineering Management		Spain	
Universidad de Valladolid	Masters Industrial Engineering			Spain	
Linkoping Institute of Technology	Masters Industrial Engineering and Management			Sweden	
Aston University	MSc Engineering Management			United Kingdom	
Total 31	22	4	0	19	27
Average					13.5

Appendix T

ASEM EM-List: Faculty Staff

Table 41: ASEM EM-List: Faculty Staff

University	Master's	PhD	Bachelor's	Average Faculty Staff
University of Alabama - Birmingham	- MS, Engineering Management			
University of Alabama - Huntsville	- MSE, Engineering Management	- PhD, Engineering Management		6
University of Alaska - Anchorage	- MS, Science and Engineering Management			4
University of Alaska - Fairbanks	MS, Construction Management			
Arizona State University	- MS Tech, Management of Technology			
Northern Arizona University	MS, Project Management			
University of Arizona	- MS, Engineering Management			19
Arkansas State University	- MS, Engineering Management			1
University of Arkansas	- MSE, Engineering Management			
California State Polytechnic University - Pomona	- MS, Engineering Management			14
California State University - East Bay	- MS, Engineering Management			12
California State University - Long Beach			- BS, Construction Engineering Management	21
California State University - Northridge	- MS, Engineering Management			9
National University	- MSE, Engineering Management			12
Northcentral University	- MBA, Specialty in Business and Technology Management			

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Table 41 – continued from previous page

University	Master's	PhD	Bachelor's	Average Staff	Faculty
Santa Clara University	- MS, Engineering Management and Leadership	- PhD, Management and Science Engineering		12	
Stanford University	- MS, Technology and Engineering Management				
University of California - Los Angeles	- MS, Engineering Management			11	
University of California - Riverside	PGDEM, Engineering Management				
University of Southern California	- MS, Engineering Management				
University of the Pacific			- BSEM, Engineering Management	3	
University of California, Irvine	- MS, Engineering Management				
Colorado School of Mines	- MS, Engineering and Technology Management				
Colorado State University	- MM, Engineering Management Specialization				
University of Colorado - Boulder	- MSE, Engineering Management		- BSEM, Engineering Management	22	
University of Colorado - Colorado Springs	- MS, Engineering Management				
University of Denver	- MS, Technology Management				
Central Connecticut State University	- MS, Technology Management			35	
Fairfield University	- MSE, Engineering Management		- BSEM, Engineering Management	5	
University of Bridgeport	- MS, Technology Management	- PhD, Technology Management			
University of Connecticut			- BSEM, Management and Engineering for Manufacturing	13	
University of Hartford	- MS, Engineering and Management				

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Table 41 – continued from previous page

University	Master's	PhD	Bachelor's	Average Faculty Staff
University of New Haven	- MS, Engineering Management			22
Catholic University of America	- MS, Engineering Management and Organization			
Georgetown University	- MSE, Engineering Management		- BSEM, Engineering Management	7
George Washington University	- MSE, Engineering Management	- PhD, Engineering Management	- BSEM, Engineering Management	11
Florida A& M University / Florida State University (FAMU-FSU)	- MS, Industrial Engineering with Engineering Management Specialization			
Florida Institute of Technology	- MSE, Engineering Management			
Florida International University	- MSE, Engineering Management			
University of Central Florida	- MS, Engineering Management			
University of South Florida	- MS, Engineering Management			
Georgia Tech	- MS, Systems Engineering, PMASE			
Mercer University	- MSE, Engineering Management			6
University of Idaho	- MS, Masters in Engineering			8
Northwestern University	- MSE, Engineering Management	- PhD, Engineering Management	- BSEM, Engineering Management	25
Southern Illinois University	- MS, Engineering and Management			
University of Illinois at Urbana-Champaign	MS, Systems and Entrepreneurial Engineering		- BS, Systems Engineering and Design	
University of Illinois - Chicago			- BS, Engineering Management	
Indiana Institute of Technology	- MSE, Engineering Management			15

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Table 41 – continued from previous page

University	Master's	PhD	Bachelor's	Average Staff	Faculty
Indiana State University	- MS, Technology Management			22	
Purdue University	MS Graduate Degree Program			3	
Rose-Hulman Institute of Technology	- MSE, Engineering Management			8	
Trine University	- MS, Engineering Management				
Valparasio University	- MSE, Engineering Management				
Iowa State University - Ames			- BS, Engineering Management	40	
Kansas State University	- MS, Engineering Management		- BS, Engineering Management	12	
University of Kansas	- MS, Engineering Management			13	
Wichita State University	MSE, Engineering Management			19	
University of Louisville	- MS, Engineering Management				
Western Kentucky University	- MSE, Engineering Management				
Louisiana Tech University	- MEM, Engineering Management			6	
McNeese State University	- MEE, Engineering Management				
Southern University and A& M College	- MS, Engineering Management				
University of New Orleans	- MS, Engineering Management				
University of Southwestern Louisiana	- MS, Engineering Management				
John Hopkins University	- MEM, Engineering Management			35	
University of Maryland - Baltimore County	- MS, Engineering Management				

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Table 41 – continued from previous page

University	Master's	PhD	Bachelor's	Average Staff	Faculty
Merrimack College	- MSE, Engineering Management				
Northeastern University	- MSE, Engineering Management			1	
Tufts University	- MS, Engineering Management				
University of Massachusetts - Amherst	- MS, Engineering Management			2	
University of Massachusetts-Lowell	- MS, Engineering Management				
Western New England University	- MSE, Engineering Management	- PhD, Engineering Management		6	
Worcester Polytechnic Institute	- MSE, Engineering Management		- BSEM, Engineering Management		
Eastern Michigan University	- EGMT, Engineering Management				
Kattering University	- MS, Engineering Management				
Lake Superior State University			- BSEM, Engineering Management		
Lawrence Technological University	- MSE, Engineering Management				
Michigan Technological University			- BSEM, Engineering Management		
Oakland University	- MS, Engineering Management				
University of Detroit - Mercy	- MEM, Engineering Management			9	
University of MichiganDearborn	- MS, Engineering Management				
Wayne State University	- MSE, Engineering Management				
Western Michigan University	- MSE, Engineering Management			21	
Saint Cloud State University	- MEM, Engineering Management			6	

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Table 41 – continued from previous page

University	Master's	PhD	Bachelor's	Average Faculty Staff
University of Minnesota - Duluth	- MS, Engineering Management			18
University of Minnesota	- MS, Engineering Management			18
University of Saint Thomas	- MS, Technology Management			
Missouri University of Science & Technology	- MSE, Engineering Management	- PhD, Engineering Management	- BSEM, Engineering Management	20
Southeast Missouri State University	- MSTM, Technology Management		- BS, Technology Management	
University of Central Missouri	MS, Industrial Management	- PhD, Technology Management	- BS, Technology Management	
Washington University - St. Louis	- MEM, Engineering Management			7
Montana State University	- MS, Industrial and Management Engineering		- BS, Industrial & Management Systems Engineering	
Montana Tech	- MPEM, Project Engineering & Management			12
University of Nebraska - Lincoln	- MEM, Engineering Management			
Dartmouth College	- MEM, Engineering Management			10
New Jersey Institute of Technology	- MS, Engineering Management			
Rowan University	- MS, Engineering Management			
The College of New Jersey			- BS, Engineering Management	8
New Mexico Institute of Mining and Technology (New Mexico Tech)	- MS, Engineering Management			4
Clarkson University			- BS, Engineering and Management	
Columbia University	- MS, Management Science and Engineering		- BS, Engineering Management Systems	1

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Table 41 – continued from previous page

University	Master's	PhD	Bachelor's	Average Faculty Staff
Cornell University	- MS, Engineering Management			9
Hofstra University	- MS, Engineering Management			
Long Island University	- MS, Engineering Management			
New York Institute of Technology			- BS, Engineering Management	
New York University	- MS, Engineering Management		- BS, Engineering Management	
Rensselaer Polytechnic Institute	MSE, Industrial & Management Engineering Program & MS, Systems Engineering & Technology Management (SETM)		- BSIME, Industrial & Management Engineering	
Rochester Institute of Technology	- MS, Engineering Management			
State University of New York - Stony Brook	- MSE, Systems Management			
Stevens Institute of Technology	- MSE, Engineering Management	- PhD, Engineering Management	- BS, Engineering Management	4
Syracuse University	- MS, Engineering Management			
United States Military Academy at West Point	- MS, Engineering Management		- BSEM, Engineering Management	2
Duke University	- MEM, Engineering Management			14
East Carolina University			- BSEM, Engineering Management	5
North Carolina A& T State University			- BSEM, Industrial and Systems Engineering	
University of North Carolina - Charlotte	- MS, Systems Engineering & Engineering Management			16

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Table 41 – continued from previous page

University	Master's	PhD	Bachelor's	Average Faculty Staff
North Dakota State University	- MS, Industrial Engineering and Management		- BSIEM, Industrial Engineering and Management	
Oklahoma State University	- MSE, Engineering Management	- PhD, Engineering Management	- BS, Engineering Management	26
Air Force Institute of Technology	- MS, Engineering Management			26
Case Western Reserve University	- MEM, Engineering and Management Degree			11
Miami University			- BS, Engineering Management	
Ohio University			- BS, Technical Operations Management	15
University of Akron	- MS, Engineering Management			
Bowling Green State University		- PhD, Technology Management		
University of Dayton	- ENM, Engineering Management			12
Oregon State University	- MSE, Engineering Management			8
Portland State University	- MS, Engineering and Technology Management	- PhD, Technology Management		23
University of Portland			- BSEM, Engineering Management	
Bucknell University			- BS, Bachelor of Management for Engineers	
Carnegie Mellon University	- MS, Engineering and Technology Innovation Management (E& TIM)			
Drexel University	- MS, Engineering Management			23

Continued on next page

Table 41 – continued from previous page

University	Master's	PhD	Bachelor's	Average Staff	Faculty
Gannon University	- MSE, Engineering Management				
Lehigh University	MS, Management Science and Engineering				
Pennsylvania State University - Harrisburg	- MS, Engineering Management				
Pennsylvania State University - University Park	- MS, Engineering Leadership Management			12	
Point Park University	- MS, Engineering Management				
Robert Morris University	- MS, Engineering Management				
Temple University	- MS, Engineering Management				
University of Pennsylvania	Executive Master's in Technology Management		- BSE, Management & Technology	39	
Widener University	- MS, Engineering Management				
Wilkes University	- MS, Engineering Management		- BS, Engineering Management		
York College			- BSEM, Engineering Management		
Polytechnic University of Puerto Rico	- MEM, Engineering Management			11	
The Citadel Military College of South Carolina	Master of Science in Project Management		- BS, Project Management / Certificate Systems Engineering Management		
University of South Carolina - Upstate	- MS, Engineering Management				
Augustana College			- BA/BS, Engineering Management		
South Dakota School of Mines & Technology	- MS, Engineering Management		- BS, Industrial Engineering & Engineering Management		

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Table 41 – continued from previous page

University	Master's	PhD	Bachelor's	Average Staff	Faculty
Christian Brothers University	- MS, Engineering Management		- BS, Engineering Management		
Lipscomb University	- MSE, Engineering Management			2	
University of Tennessee - Chattanooga	- MS, Engineering Management		- BSEM, Engineering Management	9	
University of Tennessee Space Institute	- MSE, Engineering Management	- PhD, Engineering Management			
Lamar University	- MEM, Engineering Management			14	
LeTourneau University	- MEM, Engineering Management			1	
Saint Mary's University	- MSE, Engineering Systems Management		- BS, Engineering Management		
Southern Methodist University	- MS, Engineering Management				
Texas A & M University - College Station	- MS, Engineering Systems Management				
Texas Tech University	- MS, Systems and Engineering Management	- PhD, Engineering Management			
University of Houston	Master's Degree Program in Industrial Engineering (MIE)				
University of Texas - Arlington	- MS, Engineering Management			17	
University of Texas - Austin	- MSE, Engineering Management			10	
University of Texas-Pan American	- MS, Engineering Management				
Old Dominion University	- MEM, Engineering Management	- PhD, Engineering Management & Systems Engineering			
Virginia Tech (Virginia Polytechnic and State University)	- MS, Engineering Management				

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Table 41 – continued from previous page

University	Master's	PhD	Bachelor's	Average Staff	Faculty
University of Vermont			- BSEM, Engineering Management		
Gonzaga University			- BSEM, Engineering Management	1	
Saint Martins College	- MEM, Engineering Management		- BSEM, Engineering Management	3	
Washington State University	- MSE, Engineering Management			12	
Marshall University	- MSE, Engineering Management			15	
Marquette University	- MS, Engineering Management				
Milwaukee School of Engineering	- MSE, Engineering Management				
University of Wisconsin - Madison	- MSE, Engineering Management			15	
172	**151**	**15**	**47**	**12.6533**	