

Masters in Engineering Management/Project Management/Technology and Innovation Management



MEM CORE (7 X 10 cts)	MPM CORE (7 X 10 cts)	MTIM CORE (7 X 10 cts)
Systems Engineering & Man (ISE801) Prod & Ops Management (IPP 801) Technology Management (ITB 801) People Management (PEM 883) Financial Management (FBS 830) Strategic Management (ISM 801) Eng Asset Management & Maint (IAM 801)	Project Planning (IPM 801) Finance & Cost Management (IPF 801) Project Organisation (IHR 801) Procurement and Contract Management (IPJ 801) Risk Management (IRI 801) Quality & Integration Management (IQM 801) Need to select one of: (i) Construction Management I (KBS 803) (ii) IT and Service Project Management (IPK 803) (iii) Project Systems Engineering (ISE 802)	Fundamentals of Technology Management (ITB 802) Org & Innovation (INV 880) New Product Development (INP 880) Strategic Tech & Innov Management (IST 880) Project Economics (IBD 880) Corporate Entrepreneurship (IEE 880) ST&I Policy (ISP 880)
Mini-dissertation (90 cts) (Includes Research Methodology, Literature Survey and Report)		
ELECTIVES (2 x 10cts)		
New V& Entrepreneurship (IOE 801) Legal Aspects (ILC803) Sustainability (ILE 802) Commercialisation & IP (IKG881) Knowledge & Info Management (ILB 884)	Programme & Portfolio Management (IPM 802) Systems Thinking (IBI 801) Industrial Marketing (IIM 801)	New Product Development (INP 880) MEM, MPM) Risk Management (IRI 801) (MEM, MTIM) Project Planning (IPM 801)(MEM, MTIM) Quality Management (IKK 801) (MEM, MTIM)

Short description of modules

Commercialisation & Intellectual Property

IKG881

Modern societies increasingly depend on the development and successful commercialisation of new technology that may exist either in the form of knowledge, process, product, service, or combinations of these forms. The module addresses principles and practices required to identify and package technology so as to increase the chance of successful commercialisation. The module highlights the significance of the systems of innovation concept and emphasises the integration of innovation and technology management with entrepreneurial flair in order to facilitate successful commercialisation of technology towards the generation of economic growth, wealth and prosperity. Candidates studying the module will be required to analyse case studies and to carry out a practical exercise.

Construction Management I

KBS 803

The domain addresses the specific needs of the project manager active in the construction industry. An overview of the local and international best practise is provided. Organisational structures and role players within the construction industry are studied. The construction project management life cycle is addressed with specific reference to the design and construction processes.

Corporate Entrepreneurship

IEE 880

Corporate Entrepreneurship (CE) or Intrapreneurship refers to the means by which an organisation revitalises itself and alters its competitive contour through embarking in entrepreneurial activities which focus on innovation. CE is one of the key tools to take organisations forward in an environment faced by global challenges. This module focuses on the fundamentals of CE, how to design an entrepreneurial organisation, building cultures to support technological intrapreneurship, business model innovation, organisational digital transformation, and how to enable continuous intrapreneurial performance within a corporation.

Engineering Asset Management and Maintenance

IAM 801

Since the beginning of human history, man has continued to engineer artefacts that provide the means to enhance the way we live, often by directly replacing humans in numerous laborious and dangerous tasks. These engineered assets range from indispensable and personalisable gadgets (e.g., mobile phone) and tools (e.g., notebook computer) to small and large scale cyber-physical systems, equipment, facilities, infrastructure, machinery, and industrial plant that are deployed in all aspects of human endeavour. The module emphasises the value doctrine as the basis for managing engineered assets. Thus, the focus is on the synergy between multidisciplinary knowledge areas in science, engineering and technology, as well as the application of cross-disciplinary skills in operations, maintenance, finance, logistics, human resources, *inter alia*, to achieve effective management of engineered assets that constitute our built environment. Candidates studying the module will be required to analyse case studies and to carry out practical exercises.

Finance and Cost Management

IPF 802

The role of the engineer is to apply the wealth of scientific knowledge to produce products and services for the benefit of mankind. A design can demonstrate excellence in technical achievements but if the end user cannot afford it, the whole project will be one of futility. Taking into account the vast sums of money involved in the design, development of products and establishment of production facilities, poorly managed projects can seriously damage the profitability and survival of a company.

This course in Project Finance and Cost Management creates an opportunity for the learner to be acquainted to the theoretical principles and practical applications of finance and cost management aspects as applied to projects and programmes.

To achieve this objective, it is necessary to:

- Firstly clarify the study field of engineering economics and its function in the decision making process,
- Secondly to understand the elementary principles of cost estimation, allocation of cost elements and, financial risk management,
- Thirdly to understand the cost control principles in the management of a project or program

Financial Management

FBS 830

The aim of this module is to enhance engineering managers' understanding of Financial Management principles and its role in maximising the long term wealth of the shareholders and other stakeholders. Three major decisions are involved: Firstly capital structure decisions relate to how long term sources of finance such as debt and equity are combined in an optimal structure for the firm. Secondly capital budgeting decisions relate to how these sources are optimally invested in for instance infrastructure and manufacturing assets. Thirdly, short term decisions relate to the use of current assets and current liabilities in the best possible way. Engineering managers need to understand how the results of these three types of decisions are reflected in the financial statements of the firm. Financial principles are important in assessing the financial health of a firm, be it private or public, large or small, profit-seeking or not-for-profit. A thorough understanding of these principles and how they interact from a risk-return perspective is crucial to best serve the strategic goals of the firm.

Fundamentals of Technology Management

ITB 802

Technology is often seen as the engine of economic growth. Technology management is therefore an important function within any organisation. Technology is present over the whole lifecycle of innovation projects and its activities. The typical technology management activities are Identification, Selection, Acquisition, Learning, Exploitation and Protection. Organisations should be able to master this portfolio of technology management activities to be competitive, especially in a technology and innovation environment. The module therefore addresses themes such as Technology Intelligence and Scanning, Technology Forecasting, Emerging Technologies, Technological capability assessment and development, R&D Management, Technology Transfer, Technology Planning and Roadmapping and Technology Protection.

Industrial Marketing

IIM 801

This module will primarily address marketing in the industrial environment, not commercial environment. It is based on the principles of business to business marketing ([B2B](#)) as well as services marketing. The primary objective of this module is to provide students from a technology or engineering background with a thorough foundation of basic marketing principles and how it can be applied in practice. The areas of market segmentation, macro and micro market environment, developing a value proposition, and understanding buyer behaviour will be explained. Services marketing will include: service development and design, pricing aspects, how services are delivered, how to manage employees and customers in service delivery, managing demand and supply, marketing communication aspects, building customer relationships and loyalty, and how to recover service failures.

Information Technology and Service Project Management

IPK803

IT and service project management looks at the process of planning, organising and executing projects that achieve an organisations' specific information technology (IT) and/or service goals. Given the growth of these two industries, the objective of this module is that learners gain a practical and theoretical foundation for managing IT and service projects, while also being exposed to the latest trends, innovations and techniques (e.g. Agile) in these two related management fields. At the completion of this module learners will have gained the knowledge and skills to lead effectively and creatively by using systems thinking to solve challenges in IT product and/or service design, development, and innovation.

Knowledge and Information Management

ILB 884

Information and knowledge systems are at the heart of virtually every business interaction, process, and decision, especially when one considers the vast penetration of the Web in the last few years. Managers do not have the luxury of abdicating participation in information and knowledge system decisions. Managers who choose to do so risk limiting their future business options. This is a module about managing and using information and knowledge, presented for current and future managers as a way of introducing the broader implications of the impact of information and knowledge systems. Attention will be given to IT in very broad terms, including traditional data processing and management information systems, as well as enterprise resource planning systems, electronic commerce data resource warehousing and data mining, managerial support systems, groupware, artificial intelligence applications, and so forth. The knowledge management theme will focus on aspects such as knowledge audits and mapping, knowledge systems / processes and the link to strategy. The importance of knowledge management in future thinking processes will also be discussed.

Legal Aspects

ILC 803

The objective of this module is to present the basic principles of the law with which the project manager has to deal with during the planning and execution of a project. An introduction is presented on the sources of law, the structure of the South African legal system and representatives sources of obligations. The general law of contract is done in great detail with special reference to clauses used in contracts, different types of contracts as well as breach and remedies. Practical examples are given to enable the student to understand how the law is applied in practice. Special attention is then given to the law of

purchase and sale and to construction/engineering law (letting and hiring of work). Further attention is also given to aspects of labour law and alternative dispute resolution. Another relevant aspect discussed in less detail is representation (agency).

Mini-Dissertation

MEng: IGB 898 / MSc: ISC 898

A research project on a topic of the student's choice from any of the modules offered by the Graduate School of Technology Management is done. The work takes place under the supervision of a study leader (project adviser). In addition to the satisfactory completion of the report itself, the student also has to prepare an article based on the project and present it at the final year symposium held during November each year. Evaluation is based on the report content, article, as well as the presentation. A follow-up symposium is also held during May in the next year.

New Product Development

INP 880

The development of new products is a key business function. There is always a high risk of failure but the best companies manage to launch successful new products on a continuous basis. The objective of this module is to provide students with the concepts and insight necessary both to do product development and to manage it. The strategies, processes, tools and techniques used by leading-edge companies for new product development are introduced. The module examines different stages of product development, from idea generation to market testing and includes the assessment and selection of appropriate business models. The role and impact of fourth industrial revolution technologies, like rapid prototyping with 3D printing, are also considered. Key questions addressed in the module are: how does product/process development fit into the overall business context; what products, processes, systems or services should be developed; how does one go about developing a new product/process; and how should one measure performance in product/process development and improve? Further selected concepts and topics like design thinking, design management, success factors, relationship to systems engineering, reduction of uncertainty, and software for NPD are also introduced. Although the emphasis is on physical products, many of the concepts covered in the module are equally applicable to service development.

New Ventures and Entrepreneurship

IOE 801

This subject aims to provide a wider understanding of the concepts and importance of entrepreneurship and the requirements and processes in commercialising technology-based ventures.

The themes include methodology in screening opportunities and understanding the commercialization process; compiling Technology Entrepreneurship Strategies, Product Development Process & Business Model development; understanding and protecting Intellectual Property, funding options for Entrepreneurial Ventures and understanding the scope and content of a Business Plan.

Organisation and Innovation

INV 880

The Master module Organisation and Innovation has been designed for Master students wishing to build substantive and methodological knowledge in two profound and related disciplines and phenomena: organisation studies and innovation studies. It focuses on providing an overview of the main concepts, theoretical perspectives and models regarding organisation, technological innovation and the relationships between different forms of organisation and

technological innovation (e.g. organizing for creativity; systems supporting innovation). This module further explains innovation at several levels of analysis (individuals, teams, organisations, sectors, nations). Students are expected to apply the acquired knowledge in their workplace.

People Management

PEM 883

The aim of this course is to equip engineering managers with the key competencies they require for managing in both South African and International Engineering and Technology environments. The course focuses on key elements of organisational behavior and explains how to manage individuals, teams and organisations with regard to various dimensions of thereof including: individual diversity, emotional intelligence, motivation and team performance, communication, leadership, power and politics, organisational culture and stress, with a view to optimising performance in organisations. Furthermore, the course aims at developing an understanding of talent management processes with a focus on the relationship between the HR department and the engineering manager, the aim being to highlight the role of the latter in the management of people.

Procurement and Contract Management

IPJ 801

Most projects contract out some if not all project work to other organisations or internally. Procurement is the process of selecting, contracting and acquiring goods, services or works from an external source and is thus a vital part of project management. The objective of this module is that learners are able to select and apply a meaningful and sensible procurement strategy appropriate to the project. Topics to be covered include the procurement decision; law of contract, the procurement process; various aspects of procurement planning such as procurement methods, source selection, risk allocation, contracting strategies, contract payment types, standard forms of contract; control and dispute resolution.

Production and Operations Management

IPP 801

This module presents an integrated perspective on the central role of production and operations (manufacturing and services) within industrial enterprises and covers the spectrum of systems, products and services. Firstly, the module deals with the role of the production and operations function in the enterprise and its interaction with the other functions in the organisation, emphasising aspects like customer requirements, competitiveness and measurements. An overview of the different types of production/operations processes is also provided. Secondly, the basic elements within the POM environment are covered in detail and include day-to-day operations management decisions, master planning consisting of demand management, production and capacity planning and the master production schedule, in/outsourcing, scheduling and inventory reduction. TOC with its foundation as a continuous improvement management approach is central to the module. The aim is to supply the student with background knowledge to understand the principles of production and operations management applicable to all industries and types of organisations.

Programme & Portfolio Management

IPM 802

This module introduces programmes, portfolios, the basics of corporate strategy, as well as the processes that link projects to strategy.

The processes include: screening and selection of projects; portfolio design for strategic fit and balance; allocation (and scheduling) of funds and other key resources to selected projects; the interface to detailed planning, execution, and gate reviews; as well as benefit assessment of individual projects and programmes.

Attention is paid to the roles of PM methodologies, front-end loading, feasibility studies and business cases in the process of project screening, as well as to techniques used to assess projects individually and relative to one another.

The roles of individuals and groups such as the Corporate Board, executives, steering committees / review boards, a project management office, a project portfolio manager and the project sponsor in the processes that link strategy and individual projects are described.

Project Economics

IBD 880

The module Project Economics, IBD 880, will focus on insight in the field of Decision Analysis (DA), Risk Management (RM) and Techno-Economic Analysis (TEA), with the application of the basic principles of decision analysis, risk identification, feasibility assessment and financial return in the context of innovation and technology activities within the enterprise. Theory as well as practice are important and is illustrated by for example the application of DA and TEA in various functional areas of the enterprise. Techno-economics analysis (TEA), also referred to as economic feasibility studies, is a core technique which is used to support decision making within the technology and innovation context of enterprises. Some of the fundamental approaches for DA, RM and TEA use the generic models of net present values, discounted cash flows, internal rates of return and the time value of money to compare expenses against earnings. In this module, aspects of the principles of techno-economics and the structure of TEA will be integrated with DA and RM to support and guide decisions relating to investment in, for example, future technology and innovation projects.

Project Organisation

IHR 801

This module takes an in-depth look at the conscious and unconscious human dynamics that affect the performance of project teams. The importance and complexity of the project manager's leadership role in containing and transforming anxiety into creative and productive energy is emphasized. The systemic relatedness between project teams and the social systems (organisation, industry, nation state) they form part of, and what this asks of the project manager, are explored. The module looks at the dynamics of authority, delegation, roles, boundaries, change, diversity, inclusion and exclusion and how the less obvious dimensions of these dynamics can be observed and responded to. The idea of the system-in-the-mind and how this influences the 'mind-of-the-system' is studied and experienced in class. The module draws on literature from the fields of organizational behaviour, leadership, systems psychodynamics and group relations. The module consists of self-study, experiential discussions in class, group work and individual work.

Project Planning

IPM 801

Project Planning introduces the learner to the basic concepts of project management. This module will set the scene for the rest of the MPM course and addresses project management principles, standards, guidelines, institutes, certifications, professionalism and best practices. Defining and designing a project life-cycle is discussed followed by the process of initiating and planning a project. The importance of a well-defined scope statement and work-breakdown structure are explained which will include needs analysis, user requirement definitions and systems thinking. Time management remains

integral with different scheduling techniques addressed and applied. The last part of the module provides an overview of the module to follow and how each will fit into the total discipline of project management.

Project System Engineering

ISE 802

The PSE process is discussed within the context of the technology-based enterprise. The first objective is to conceptualise and model a tech-based enterprise in terms of core business processes and the interaction amongst them. SE processes are hence understood in the context of the project and organisation. The concepts of “system, project and process” are explained.

The design and development of the total system for the total system life-cycle, taking into account the requirements of all stakeholders is the heart of PSE. All stakeholders and their requirements are identified, described and managed over time. The system life-cycle stages/phases and related system design processes are focused upon. A number of SE topics, e.g. information and configuration management, life-cycle cost, quality of design, downstream “design to” requirements and logistics are touched on. SE planning within the bigger Project plan is investigated. The important and integrating role of the Project Manager to make SE successful, particularly in the early phases of the project, is highlighted.

Quality and Integration Management

IQM801

The module details the quality journey in projects and how all project knowledge areas are integrated into a final project plan to ensure the quality of project management. It further addresses the quality of the project’s products through the proper definition of the project business case, scope definition and the breakdown of the project’s products into manageable deliverables that will meet stakeholder expectations. Though specification development of the deliverables using quality planning (QP) techniques, the quality metrics or quality measurement criteria for the specification will be established. These criteria will form part of the project’s quality assurance plan (QAC) which is integrated with the project’s life cycle and schedule as well as management and approval authorities. Quality control (QC) and quality assurance (QA) processes and activities to test, verify and audit product, support as well as managerial processes and deliverables are also discussed and non-conforming elements are recommended for improvement through the use of quality improvement tools and techniques. The use of quality standards and methodologies to enhance the quality of projects is also discussed. The module concludes with the development of an integrated project plan, incorporation all knowledge areas addressed in the different modules of the programme.

Quality Management

IKK801

The general objective with this module is to emphasise understanding and application of the concepts of quality management within technological enterprises. The module focuses on important concepts and definitions of quality such as quality in design and processes to ensure customer satisfaction. The role and relevance of quality management systems and standards. The link between quality and competitive advantage, leadership, ethics, culture, empowerment, partnering and teamwork. The measurement of quality and the use of tools and techniques for process and product improvement. Organisational quality management implementation strategies.

Risk Management

IRI 801

The module Risk Management, IRI 801, focuses on insight in the field of Risk Management and the application of the basic principles of risk identification, assessment, treatment and control in the business enterprise and also systems technology innovation and project management. Theory as well as practice is important and a number of case studies are used to illustrate the application of risk management in various functional areas of the enterprise. Risk can be defined as "the presence of adverse events or conditions that can threaten the survival of the system, or prevent the objectives of the system to be achieved". All systems including project or technology systems, natural and human-made, are exposed to risk and this risk should be managed in a responsible way by any business enterprise. The risk exposure of modern organisations is increasing due to complex technical systems, resource structures, processes and interactions. The risk management process involves establishing the goals and objectives for the organisation or functional unit, identifying the risks, quantifying and prioritising the risks, developing responses to the high priority risks, and monitoring the operations. Business enterprises in the manufacturing and service industries have a number of functional areas and processes that are interlinked. Risk management and decision analysis are therefore applied in development of new products or services, operations, maintenance, projects, safety and security. The module also includes aspects of detailed risk analysis such as risk simulation etc.

Science, Technology and Innovation Policy

ISP 880

Science, Technology & Innovation (STI) policy is about decisions and actions that are taken by governments in order to promote research, technology development and innovation which are critical to economic growth and development, as well as the procurement and use of scientific knowledge in public policy-making. In this module students will be introduced to concepts of and issues in STI policy, followed by a brief history of innovation theory and how STI are critical to economic productivity and development. The range of policy instruments which can be used to stimulate STI will also be reviewed, as well as the characterisation of the instruments which have been adopted by African countries. A range of frameworks for assessing the effectiveness of different STI policies and innovation systems, with particular reference to South Africa and other African countries, forms part of this module.

Strategic Management

ISM 801

The objective with this module is to stimulate strategic thinking and the development of strategic decision making skills amongst students in the field of strategic management in an engineering environment. In this module the following topics are addressed:

Concepts and Practice of Strategy: An historical background serves as introduction. Classical concepts and misconceptions in strategic and operational management work are given.

The Process of Strategic Management: The work content and structure of strategic management are discussed. A schematic model of the process is developed.

Formulation of Strategy: This section gives a statement of the work to be done in formulation of strategy. The following aspects are covered: The company mission. External environment. Environmental forecasting. The company SWOT analysis. Formulating objectives and grand strategies. Strategic analysis and choice.

Implementation of Strategy: In the concluding part of the module attention is given to implementation through business functions, structure, leadership and culture, rewards, control mechanisms for measuring, evaluating and corrective actions.

Strategic Technology & Innovation Management

IST 880

The objective of this module is to provide students with the necessary skills to develop technology and innovation strategies for organisations. Themes include the concepts of technology and innovation strategy, processes of strategic management, formulation of technology and innovation strategies, strategy implementation, technology roadmapping, scenario development and future thinking. Appropriate case studies are used to link the theory and practice.

System Engineering and Management

ISE 801

SE & M is discussed within the context of the technology-based enterprise. The first objective is to conceptualise and model a tech-based enterprise in terms of core business processes and the interaction amongst them. SE processes are hence defined and managed in the context of the project and organisation. The concepts of “system, project and process” are explained.

The design and development of the total system for the total system life-cycle, taking into account the requirements of all stakeholders, is the heart of SE. SE & M focuses on the management of the SE process and the establishment of a SE capability in the organisation.

All stakeholders and their requirements are identified, analysed, described and managed over time. The system life-cycle stages/phases and related system design processes are focused upon. A number of “specialty engineering topics”, e.g. information and configuration management, life-cycle cost, quality of design, downstream “design to” requirements and logistics are touched on. The enabling role of SE within Engineering Management is emphasised.

Systems Thinking

IBI 801

The modern world consists of “systems”. This is evident from everyday discussions. Statements such as “The system failed us”, or “The national energy system is under pressure” abound. Most people have little or no understanding of what a system is, or how to deal with it. Digging deeper into the concept of “system” leads one to realise that engineers and scientists without any working knowledge of “systems thinking”, or as some describe it, “thinking in systems”, rarely succeed when attempting to solve the problems of our time mainly because they do not know how to deal with trending patterns. Peter Senge, author of the book *The Fifth Discipline* and well-known systems thinker, defines systems thinking as “both a thinking skill and a language for understanding and working with complexity”. This course will provide you with the know-how and tools to achieve the desired outcomes in your real-world environment, notably when that world includes complex and wicked problems. The real-world in this case includes people as well. This course will challenge almost everything you have been taught to date. After completing this course you will view the world in a different way. You will become a big picture thinker who can transcend your own discipline with ease. The course includes the history and benefits of systems thinking, systems thinking terminology, managing interrelationships, overview of appropriate tools and methodologies including system dynamics, soft systems methodology, systemigrams, etc.

These will be illustrated further by applying them to relevant case studies. This course is the ideal compliment to systems engineering, which focuses mainly on hard systems whereas systems thinking focuses on soft systems.

The role of projects in realizing (more) sustainable business strategies and a more sustainable society is one of the emerging topics in project management. From the literature on this topic, two types of relationship between sustainability and project management appears: the sustainability of the project's product, the deliverable the project realizes, and the sustainability of the project's process of delivering and managing the project. The first relationship, sustainable projects, is well studied and addressed, for example in relationship to eco-design and 'green' construction. The second relationship, sustainable project management, is emerging as a new 'school of thought' in project management.

As project managers play a pivotal role in the sustainability of their projects, this course will discuss the 'why?', 'what?' and 'how?' of sustainable project management. The lectures will discuss the concepts of sustainability, the role of projects in sustainability, the impact of sustainability on project management, the integration of sustainability in the project management process and the structure of a 'Sustainability Management Plan'.

Sustainability

ILE 802

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Technology Management

ITB 801

Technology is important for an organisation's competitiveness and productivity. Technology management is therefore an important function within any organisation, whether it be as a core resource of technology-based companies or as a support resource in service organisations. Technology is present over the whole lifecycle of projects and operations with technology management activities such as Identification, Selection, Acquisition, Learning, Exploitation and Protection. The module therefore addresses themes such as Technology Dynamics, Technology Identification, Technology Audits, Technology Selection, Technology Roadmapping, Technology Acquisition, Technology Adoption, Technology Management in the operational lifecycle.