

**METIIB Course
Handbook 2019-20**

Disclaimer

We have endeavoured to ensure that the information contained in this handbook is as accurate as possible. However, it is likely that minor changes and updates may need to be made to some sections during the course of the year. This is very likely with the module timetables where, due to circumstances beyond our control, some aspects of the delivery may change.

We will ensure that all updates are communicated to you by email and/or posted on the MET IIB Moodle site.

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Introduction

MET IIB Teaching Staff



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IIB Modules: Sustainable Manufacturing, Production Technologies and Materials



Dr Thomas Bohné

IIB Modules: Technology and Innovation Management.



Dr Alexandra Brintrup

IIB Modules: Industrial Operations Management



Dr Ronan Daly

IIB Modules: Production Technologies and Materials

METI IA Course Director



Dr Michaël De Volder

Industrial Projects

IIB Modules: Production Technologies and Materials



Prof Steve Evans

IIB Modules: Sustainable Manufacturing



Dr Niamh Fox

IIB Modules: Production Technologies and Materials



David Leal-Ayala

IIB Module: Enterprise, Globalisation and Policy



Dr Mark Khater

IIB Modules: Strategy and Marketing



Dr Mukesh Kumar

Industrial Projects

IIB Modules: Industrial Operations Management



Prof Tim Minshall

MET IIB Course Director

IIB Modules: Induction; Enterprise, Globalisation and Policy; Technology and Innovation Management, Leadership and Managing People



**Prof Rick Mitchell RAEng
Visiting Prof**

IIB Modules: Technology and Innovation Management



Dr Veronica Martinez

Industrial Projects

IIB Modules: Strategy and Marketing, Industrial Operations Management



Dr Dai Morgan

IIB Modules: Sustainable Manufacturing



Dr Letizia Mortara
Industrial Projects
IIB Modules: Technology and Innovation Management



Dr Sebastian Pattinson
Industrial Projects



Prof Duncan McFarlane
IIB Modules: Manufacturing Systems Engineering;



Simon Pattinson
IIB Modules: Strategy and Marketing



Prof Bill O'Neill
IIB Modules: Production Technologies and Materials



Dr Frank Tietze
Industrial Projects Coordinator
IIB Modules: Induction; Technology and Innovation Management.



Dr Eoin O'Sullivan
IIB Modules: Enterprise, Globalisation and Policy;



Alan Thorne
Industrial Projects
IIB Modules: Manufacturing Systems and Engineering, Automation Lab



Dr Ajith Kumar Parlakad
Industrial Projects
METIIB Chair of Examiners



Dr Florian Urmeterz
IIB Modules: Production Technologies and Materials



Dr Rob Phaal
IIB Modules: Technology and Innovation Management



Dr Chander Velu
IIB Modules: Strategy and Marketing



Dr Daniel Summerbell
IIB Modules: Sustainable Manufacturing

IfM Teaching Office Staff



Shane Strawson
Senior MET Administrator



Sally King
Senior ISMM Administrator



Megan Flood
Administrator

IfM Teaching Support Staff



Lewis Grantham
Computer Officer



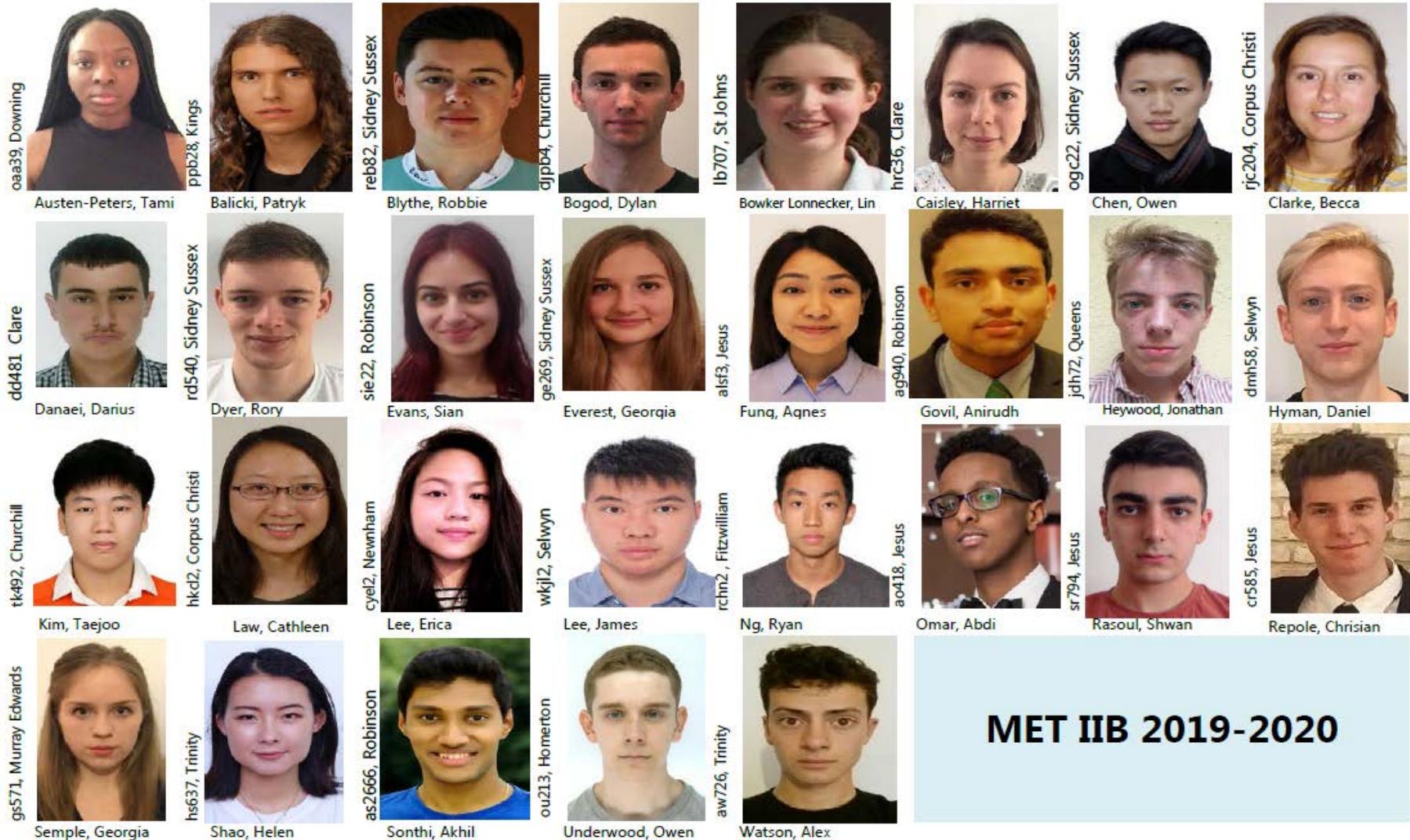
Giles Hainsworth
Senior Computing Technician



Chris Jennings
Workshop Technician



Simon Sennitt
Workshop Technician



MET IIB 2019-2020

Aims, Learning Style and Professionalism

Course Aims

MET aims to provide those with leadership potential with a thorough grounding in management and manufacturing technologies, together with an understanding of the full range of industrial activities: from product design, component manufacture, industrial engineering, factory and business management through to how firms work in the economy. A core message throughout the programme is to understand how firms can grow sustainably.

Learning style

MET IIB builds on the foundations provided in the third year, with a combination of modules introducing issues of strategic relevance to firms and modules that drill deeper into ideas introduced in MET IIA. MET IIB represents a substantial departure from the standard university timetable and approach. Modules and practical activities run in sequence, with a module typically lasting one week. Teaching in the modules is seminar based, to encourage interaction and participation. Industrial speakers supplement the theory, with examples from practice. Throughout the year, you will get to apply the principles in company-based project work.

Professionalism

The success of the MET depends on maintaining a close working relationship with a large number of companies. **For the course to be successful, and for us to maintain the high level of support from industry that we currently enjoy, it is essential that all our engagements with industry – be they hosting guest speakers, making company visits or working on company-based projects – are conducted in a highly professional manner.** Without spelling out what this means, a guideline is that course members are expected to behave at all times in the same way as if they were employed as professional engineers.

All MET staff take their roles as education professionals extremely seriously and want to ensure that MET is as effective and efficient as it can be at achieving the course aims. To help ensure this, there is an MET Staff Student Joint Committee (SSJC). The SSJC meets once per term and is chance for staff and students to raise any issues for discussion and action. The SSJC comprises two representatives each from MET IIA and MET IIB, the MET Senior Administrator, and the two MET directors. Volunteers for the student representative roles will be sought during MET IIA and IIB inductions.

Key dates and assessment

MET IIB Year Planner 2019-2020

Week no/day	Week starting	Content
		Full term starts Tuesday 8th October 2019
0 Mon	7 th October 2019	Induction / Induction Project Preparation
0 Tue	8 th October 2019	Induction / Enterprise, Globalisation and Policy Module
1 Wed	9 th October 2019	Induction Project
1 Mon	14 th October 2019	Strategy and Marketing
2 Mon	21 st October 2019	Technology and Innovation Management
3 Mon	28 th October 2019	2 week project
4 Mon	4 th November 2019	2 week project
5 Mon	11 th November 2019	Manufacturing Systems Engineering (MSE)/Robot Lab
6 Mon	18 th November 2019	Robot Lab
7 Mon	25 th November 2019	Industrial Operations Management
8 Mon	2 nd December 2019	Leadership and Managing People
		Full term ends Friday 6th December 2019
9 Mon	9 th December 2019	Robot Lab
		Full term starts Tuesday 14th January 2020
0 Mon	13 th January 2020	Production Technologies and Materials
1 Mon	20 th January 2020	Production Technologies and Materials
2 Mon	27 th January 2020	4 week project 1
3 Mon	3 rd February 2020	4 week project 1
4 Mon	10 th February 2020	Sustainable Manufacturing
5 Mon	17 th February 2020	Overseas Research Project Preparation
6 Mon	24 th February 2020	4 week project 2
7 Mon	2 nd March 2020	4 week project 2
8 Mon	9 th March 2020	Long Project preparation
		Full term ends Friday 13th March 2020
		Full term starts Tuesday 21st April 2020
0 Tue	TBA	Examinations
1 Mon	27 th April – 5 th June 2020	Long Project – 6 weeks
7 Mon	8 th June 2020	Cambridge based
		Full term ends Friday 12th June 2020
	15 th June 2020	May Week
	22 nd June 2020	Overseas Research Project preparation
	29 th June 2020	Overseas Research Project

Project Report Hand-In Dates 2019-2020

Project Period	Latest time for delivery to MET Office	Last Date for Supervision with Project Supervisor	Date Corrected Report due into MET Office
Induction Project 9 October to 11 October	Time: 23:59 Date: Sunday 13 October	Friday 18 October	Time: 23:59 Date: Tuesday 22 October
Michaelmas Project 2 weeks: 28 October to 8 November	Time: 23:59 Date: Sunday 10 November	Friday 15 November	Time: 23:59 Date: Tuesday 19 November
Lent Project 4 weeks: 27 January to 7 February 24 February to 6 March	Time: 23:59 Date: Sunday 8 March	Friday 13 March	Time: 23:59 Date: Sunday 15 March
Long Project: 9 to 13 March 27 April to 5 June	Time: 23:59 Date: Sunday 7 June	Friday 12 June	Time: 23:59 Date: Monday 15 June

Staff Student Joint Committee meetings 2019-2020

Term	Date	Time
Michaelmas	21 November 2019	13:00 – 14:00
Lent	20 February 2020	13:00 – 14:00
Easter	To be confirmed	To be confirmed

Project, Coursework & Examination Credit for Part IIB of MET

From the Secretary of the Faculty Board of Engineering

The Examiners for Part IIB of the Manufacturing Engineering Tripos will take account of work produced by candidates. The Faculty Board have determined that this shall consist of work with the requirements and total marks available set out below.

300 marks divided as follows:

Manufacturing systems and robot lab	55 marks
One two-week industrial assignment	45 marks
One four-week industrial assignment	80 marks
Individual long project	120 marks

300 marks in total are available for the examination papers:

Two written papers, each marked out of 100	200 marks
Teaching modules, combined mark	100 marks

Some questions in the written papers may be based on written material provided by the examiners in advance; such material will be included as part of the examination paper and candidates may not bring any papers into the examination.

Students are expected to undertake all the coursework as specified above. No allowance will be made for absence unless it is due to illness or other grave cause, and will be made then only if the reasons are presented in writing by the student's Tutor and are found to be acceptable by the Head of Department. Details of allowances approved by the Faculty Board can be found in the 'Allowances for Illness' document, under the relevant Tripos year, on the CUED undergraduate teaching web page.

Work submitted for marking must be that of the student who submits it.

Notes:

Module assessments marks

Production Technologies and Materials	30 marks
Sustainable Manufacturing	14 marks
Industrial Operations Management	14 marks
Technology and Innovation Management	14 marks
Strategy and Marketing	14 marks
Leadership and Managing People	14 marks
Total	100 marks

Distinction, Merit, Pass and Fail

"Candidates who achieve a first-class standard in both examination and coursework credit will be awarded a Distinction. Candidates who have not obtained a Distinction but achieve at least a II.1 standard in both elements will be awarded a Merit. The pass standard for the award of the MEng degree will require at least a II.2 standard in both elements."

From the Cambridge University Reporter 6388

"Manufacturing Engineering Tripos, Parts IIa and IIb
(Statutes and Ordinances, p. 375)

With effect from 1 October 2015

The General Board, on the recommendation of the Faculty Board of Engineering, have approved amendments to the regulations for the Tripos as follows: with the Faculty Board's permission, to allow students to present themselves for honours in Part IIa in the year next but one after obtaining honours in Part Ib of the Engineering Tripos; to clarify that candidates spending terms studying at a certified institution shall be deemed to have kept those terms; and to allow candidates on approved placements outside the University's Precincts to count terms towards residence.

Regulation 2.

By amending Regulation 2 so as to read:

2. The following may present themselves for honours in Part IIa:

- (a) a student who has obtained honours in Part Ib of the Engineering Tripos or in Part I of the Chemical Engineering Tripos may be a candidate for honours in Part IIa of the Manufacturing Engineering Tripos in the year after so obtaining honours;*
- (b) a student who has obtained honours in Part Ib of the Engineering Tripos may be a candidate for honours in Part IIa of the Manufacturing Engineering Tripos in the year next but one after so obtaining honours, provided that he or she presents a reasoned case to the Faculty Board by the division of the Easter Term of the year in which Part Ib is taken; provided always that the student has kept seven terms and that twelve complete terms have not passed after her or his first term of residence.*

Regulation 4.

By inserting the following words 'and to have kept those terms for the purpose of the regulations for Residence and Precincts of the University' at the end of the first sentence.

Regulation 5.

By inserting new Regulation 5 as follows and renumbering the remaining regulations:

5. Attendance by candidates for the Part IIb examination on placements outside the University precincts, under arrangements approved by the Faculty Board of Engineering, shall count towards the keeping of terms for the purpose of the regulations for Residence and Precincts of the University."

<https://www.admin.cam.ac.uk/reporter/2014-15/weekly/6388/section5.shtml>

Module Specifications and Timetables

Introduction

The MET IIB taught modules mark a significant change from the traditional academic undergraduate programme of lectures, to a more professional ‘real world’ approach of intensive courses lasting from a few days up to two and half weeks.

Aims

The aims of the taught modules are to:

1. present new teaching material and concepts, building on the fundamentals of manufacturing presented in MET IIA;
2. demonstrate the challenges of applying concepts to different company situations;
3. demonstrate that ‘real world’ situations are complex, requiring decisions based on incomplete data, and that in any given situation there is rarely an obvious or correct way forward;
4. enable students to practice critical group skills of team-working, discussion, influence, persuasion, consensus building, decision making and presentation.

Style

Each module contains a variety of activities designed to encourage discussion and active participation. These include presentations from lecturers and visiting speakers, industrial visits, class discussions, exercises, group activities and case studies.

Attendance

The nature of the modules means full attendance throughout is expected: the taught material is not readily available in text books and much of the learning comes from class and small group discussion. The assessment and examinations assume full attendance on modules and visits, and full participation in the group discussions, exercises and cases.

Students are advised to keep clear and well indexed notes of all module activities.

Students should notify the IfM Teaching Office as soon as possible if they know they will be unable to attend any of the teaching sessions.

Assessment

Most modules are subject to end of module assessment, normally a short written examination or a piece of course work. The assessments form a significant part of the overall assessment for the year.

Students should carefully note the assessment times as no allowance can normally be made for absence.

Module Specifications

Detailed modules specifications are given in the following pages. Each specification includes module learning outcomes, model module timetables, session contents and learning outcomes, and assessment.

MET-IIB-1: Induction Module (Including Enterprise, Globalisation and Policy)

Module Leader: Prof Tim Minshall

Other IfM staff: Dr Frank Tietze, Dr David Leal-Ayala

Dates: Monday 7 October 2019 – Friday 11 October 2019

Location: Lectures in Alan Reece Building, Lecture Room 2;
Projects at company locations away from Cambridge

Assessment: Lectures – Assessed as part of the end of year exam (Paper 2) only
Projects – Indicative assessment of project which does not count towards final mark

Module Learning Outcomes

By the end of the module students will:

1. Understand the structure of MET IIB, learning approaches, key dates, assessment methods, expectations and responsibilities.
2. Appreciate the range of possible research methods available when undertaking research to answer different types of questions.
3. Have experienced the METIIB style industrial project work, and applied research skills and team-based project management skills in an industrial context.
4. Understand that manufacturing is complex and must adapt to a complex, uncertain and dynamic environment.
5. Explain how companies do and might respond to these changes and subsequent industrial transformations.
6. Understand how and why governments are responding to help companies navigate the complexity and operate in an uncertain and changing environment through industrial and innovation policies.

Students will also have;

1. Had experience of analysing complex multi-dimensional problems;
2. Questioned the efficacy of information and tools;
3. Developed their presentation and exam skills for questions relating to complex “messy” issues.

Induction Module (Including Enterprise, Globalisation and Policy) This timetable may be subject to changes

Time	Monday 7 October	Tuesday 8 October	Wednesday 9 October	Thursday 10 October	Friday 11 October
0900-1030	Introduction, How to succeed on MET IIB, METIIB Structure, timetable and key dates. <i>Tim Minshall, Teaching Office team</i>	09:00 – 10:00 Complex and changing industrial landscape <i>David Leal-Ayala and Tim Minshall</i>			Induction projects at companies
Coffee					
1100-1230	Essential MET IIB skills <i>Frank Tietze</i>	How do firms and governments respond to the changing landscape? <i>David Leal-Ayala and Tim Minshall</i>			Induction projects at companies
Lunch					
1330-1500	Introduction to MET IIB projects & mapping techniques <i>Frank Tietze</i>	Meetings with supervisors / travel to projects			Induction projects at companies
Tea					
1530-1630		Meetings with supervisors / travel to projects			Induction projects at companies

Induction – Syllabus and Learning Outcomes

Syllabus	Learning Outcomes
How to succeed at MET IIB	To understand the learning aims and approach of MET IIB, and how it differs from MET IIA. Appreciation of the differences between MEng and BA-level learning.
Structure, timetable and key dates	To understand the structure of MET IIB, key dates, assessment methods, expectations and responsibilities.
Essential MET IIB Skills	To understand some major challenges when doing research and conducting professional projects to answer different types of questions or rather solve certain problems. To appreciate the relative merits and weaknesses of different research methods. To understand why certain conventions are helpful to create projects with impact. To know where to find more information on using different research methods. To understand the importance of evidence-gathering for industrial projects, and how to apply different methods in an industrial project context.
Introduction to industrial projects in MET IIB, and mapping techniques that can be used in industrial projects.	To understand the role of industrial projects within MET IIB To be aware of a range of possible mapping techniques that can be used for industrial projects; to have basic knowledge of the relative merits and weaknesses of each.
Complex and changing industrial landscape	Understanding that manufacturing is complex and must adapt to a complex, uncertain and dynamic environment.
How do companies and governments respond to the changing landscape	Understand how companies do, and might, respond to these changes and subsequent industrial transformations. Recognition of the complexities and trade-offs that companies must deal with when selecting and implementing new strategies. Understand how and why governments are responding to help companies navigate the complexity and operate in an uncertain and changing environment through industrial and innovation policies. Recognition of the complexities and trade-offs that are a feature of policy implementation.

Induction Projects	<p>To be aware of the key functions in a typical manufacturing company, and the connections between them.</p> <p>To experience the MET IIB style industrial project work.</p> <p>To have applied skills of evidence gathering, analysis, interpretation, collation and presentation.</p> <p>To have applied the interpersonal and project management skills necessary to work as part of a team within an industrial context and specific time-constrained objective.</p>
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Reading list:

Module resources given on Moodle.

MET-IIB-2: Strategy and Marketing

Module leader: Dr Veronica Martinez

Other IfM staff: Simon Pattinson, Dr Mark (Mohamed) Khater, Dr Mohamed Zaki

Dates: Monday 14 October – Friday 18 October 2019

Location: Alan Reece Building, LR2

Assessment: Electronic submission at: met-admin@eng.cam.ac.uk

Submission Deadline: Friday 18th Oct 2019; 23:59 hr. British Summer Time

Module Learning Outcomes

On completion of the module students should be able to:

- Describe and apply appropriate processes and frameworks for the development of a business linked manufacturing strategy, including relevant performance measures.
- Describe the stages in the development of marketing as a function, and apply classical marketing techniques and frameworks at business unit and product levels.
- Use the principles of brand identity to develop an appropriate marketing and advertising strategy for a product.
- Demonstrate knowledge and understanding of the role of product management, and its implementation in different business contexts.

Strategy and Marketing 14 – 18 October 2019 This is a draft timetable and may be subject to changes

Time	Monday 14 Oct	Tuesday 15 Oct	Wednesday 16 Oct	Thursday 17 Oct	Friday 18 Oct
0900-1030	09:00-10:00 Projects briefing <i>Frank Tietze</i> Intro to the module The Marketing Audit <i>Simon Pattinson</i>	Product Management <i>Chris O'Connor</i> <i>CEO Techcomp Europe</i>	Marketing – Objectives and Market based approach to Strategy <i>Simon Pattinson</i>	Performance Measurement Theory and Cases <i>Mohamed Zaki</i>	Assessment case study preparation
	Coffee break				
1100 -1230	Marketing Audit (cont.) <i>Simon Pattinson</i>	Brands & Branding in the 21 st Century <i>Martin Dinkele</i> <i>SVP Savanta</i>	Social Media Marketing and Strategy <i>Guy Peters</i> <i>Formerly Ogilvy and Mather</i>	Business Strategy - Resource/competency based approach. Corporate Strategy & Operations Strategy <i>Mark Khater</i>	Assessment case study preparation
	Lunch				
1330 -1500	Strategic marketing case study <i>Simon Pattinson</i>	The Development of Brand Strategy <i>Martin Dinkele</i> <i>Simon Patterson</i> <i>QRi Consulting</i>	Free	Cont.	Assessment case study preparation
	Tea				
1530 -1700	Product/Market lifecycles <i>Simon Pattinson</i>	Brands case study <i>Martin Dinkele</i> <i>Simon Patterson</i>	Free	Cont.	Module assessment – case study written analysis. Submission Time 23:59 hr BST

Strategy and Marketing: Syllabus and session learning outcomes

Syllabus	Session learning outcomes
The Nature and Role of Marketing The development of marketing as a business function Consumer and B2B markets The role of marketing at corporate, business unit, and product levels The marketing process – internal and external analysis	Describe the historical development of marketing as a business function. Discuss marketing as a socio-economic process. Marketing as a business philosophy: the marketing concept, market orientation, why is marketing important to firms? Marketing as a business function. Marketing mix and the marketing environment.
Marketing Objectives and Strategy Creating strategic advantage – how, direction, method Different market strategies Developing a marketing plan – 4Ps - Segmentation, targeting, positioning	Describe the customer value proposition: The components of the marketing plan; conducting marketing research and forecasting demand. Describe consumer behaviour: stages in the consumer and organisational buying process; variations in the buying process. Segmentation: how to identify segments of customers within markets. Targeting: identifying segments to target. Positioning: achieving a superior position in the minds of customers relative to competitors.
Product Management Example of the core processes used in product management in firms: - integration across the supply chain – market research, selection, development, manufacture and sales - relationship between R&D and marketing - focus on product life cycle management	Describe the role of product management and the core processes used. Describe the product life cycle: its stages and determinants. Managing demand, the product mix and the marketing mix over the life cycle. New product development: strategies and risks.
Brand Strategy The development of market focused organisations; understanding brands. The classical view based on the extended product; classical brand strategy process; problems. Changing views about brands – development of brand identity concepts, the brand identity prism, brand identity management	Describe the development and meaning of a market focused organisation Describe the classical approach to brand strategy and apply the processes to a particular product range Apply the concept of the brand prism to a range of products to develop an appropriate advertising and marketing campaign.

<p>Manufacturing Strategy</p> <p>Strategy frameworks</p> <p>The importance of strategy alignment</p> <p>Competitive criteria</p> <p>Structural and infrastructural factors</p>	<p>Discuss and apply the stages in the development of a business linked manufacturing strategy</p>
<p>Performance Measurement</p> <p>Why companies need to measure performance</p> <p>Performance Measurement frameworks</p> <p>How to link measures to strategy</p> <p>How to develop appropriate performance measures</p> <p>How to manage using performance measures</p>	<p>Describe the role of performance measurement in the successful management of a business.</p> <p>Demonstrate the application of key concepts to a business case.</p>
<p>Social Media Marketing and Strategy</p> <p>The application of social media methods as part of the marketing strategy of an organisation</p> <p>The role that such methods can play in the marketing mix</p> <p>Relevance in different company contexts</p>	<p>Describe how social media may be deployed in a marketing context, and the part they can play in implementing a strategy for a particular business</p>

Reading list

- Kotler, P., Keller, K.L. & Brady, M. (2012). *Marketing Management*, Prentice-Hall/Pearson Education, 2nd edition.
- Kumar, N. (2004). *Marketing as Strategy: Understanding the CEO's agenda for driving Innovation and Growth*, Harvard Business School Press.
- Mills, J. F., Platts, K. W., Neely, A. D., Richards, A. H., & Bourne, M. C. S. (2002). *Creating a Winning Business Formula*: Cambridge University Press. ISBN: 0-521-75029-6.
- Mills, J. F., Platts, K. W., Bourne, M. C. S., & Richards, A. H. (2002). *Competing through Competences*: Cambridge University Press. ISBN: 0-521-75030-X.
- Neely, A. D., Bourne, M. C. S., Mills, J. F., Platts, K. W., & Richards, A. H. (2002). *Getting the Measure of your Business*: Cambridge University Press. ISBN: 0-521-75031-8.
- Aaker, David (2010). *Building Strong Brands*, Pocket Books.
- Kapferer, Jean-Noël (2012). *The New Strategic Brand Management*, Kogan Paul.
- De Chernatony, Leslie (2001). *From Brand Vision to Brand Re-evaluation*, Butterworth Heinemann.
- Lannon, Judy and Baskins, Merry (2009). *A Master Class in Brand Planning: The Timeless Works of Stephen King*, Wiley.
- Gray, D., Micheli, P. and Pavlov, An. (2014). *Measurement Madness: Recognizing and Avoiding the Pitfalls of Performance Measurement*, John Wiley & Sons.
- Mayer-Schonberger, V. and Cukier, K. (2013). *Big Data: A Revolution That Will Transform How We Live, Work and Think*, John Murray.
- Siegel, E. (2013). *Predictive Analytics: the Power to Predict Who Will Click, Buy, Lie, or Die*, John Wiley & Sons.

MET-IIB-3: Technology and Innovation Management

Module leader: Dr Frank Tietze

IfM staff: Dr Thomas Bohne, Prof Tim Minshall, Prof Rick Mitchell, Dr Letizia Mortara, Dr Rob Phaal.

Dates: Monday 21 October – Friday 25 October 2019

Location: Alan Reece Building, Lecture Room 2

Assessment: End of module written assessment
LT2 – Friday 25th October, exact time to be confirmed.

Module learning outcomes: On completion of this module, students should be able to:

Demonstrate knowledge and understanding of:

- practically relevant technology and innovation management tools and techniques;
- details of innovation types and innovation processes;
- the management of new product introduction (NPI);
- key technology and innovation management concepts and frameworks;
- and the context of technology and innovation management.

Demonstrate the ability to:

- evaluate technologies and innovations, and select appropriate approaches to manage them;
- apply tools and techniques to real business situations, cases and simulations;
- identify and critically analyse technology and innovation management issues.

The module applies a set of complementary teaching and learning techniques including lectures and a set of smaller exercises (e.g. a standardization case study and strategy development using roadmapping) as well as a complex group game and a high-profile guest talk by a former MET student plus an interactive module review.

Technology and Innovation Management 21 - 25 October 2019 This is a draft timetable and may be subject to changes

	Monday 21 Oct	Tuesday 22 Oct	Wednesday 23 Oct	Thursday 24 Oct	Friday 25 Oct
0900-1045	0900-1000 Introduction to Long Projects <i>Frank Tietze</i> 1000-1045 Module introduction Philips case, models <i>Frank Tietze</i>	Strategic technology management <i>Rob Phaal</i>	Technology intelligence <i>Letizia Mortara</i>	NPI simulation - CityCar <i>Thomas Bohne</i>	Commercialising F1 technology <i>James Colgate</i> <i>Williams Advanced Engineering</i>
Coffee					
1100-1230	Evolution of industries, technologies and markets <i>Tim Minshall</i>	Technology Roadmapping <i>Rob Phaal</i>	Technology acquisitions <i>Letizia Mortara</i>	NPI simulation - CityCar <i>Thomas Bohne</i> <i>(Runs to 13:00)</i>	Module review and key learning outcomes <i>Frank Tietze</i>
Lunch					
1330-1500	ISAEP model <i>Tim Minshall</i>	Open innovation <i>Tim Minshall</i>	Free	CityCar Debrief <i>Thomas Bohne</i> <i>(Start at 14:00)</i>	Module assessment – LT2
Tea					
1515-1700	NPI and innovation <i>Rick Mitchell</i>	Intellectual property management <i>Frank Tietze</i>	Free	Free	Free

Technology and Innovation Management - Syllabus and session learning outcomes

Syllabus	Learning outcomes
Introduction Overview of the module Philips case study Introduction to technology management frameworks and models	Understand the aims, objectives and scope of the module Describe the typical technology management challenges that technology intensive firms face Recognise the importance of technology management tools and frameworks in addressing these challenges
Evolution of industries, technologies and markets The challenge of disruptive innovations	Appreciate the dynamic nature of technologies, industries and markets, and the challenges this presents to managers Understand the particular challenges of disruptive innovations
Technology management processes (Identification, Selection, Acquisition, Exploitation, Protection (ISAEP))	List some of the typical activities that a technology intensive firm can use in each of the ISAEP processes
Innovation and new product introduction (NPI) Challenges of NPI NPI Simulation Managing the NPI process	Understand the key technical and commercial challenges of getting a new product to market Describe and apply the experience of a simulation of the process of introducing a new product to market Describe and apply the tools and techniques available to support the management of the NPI process
Strategic Technology Management Technology Road-mapping	Appreciate that all technology management decisions need to be considered in the wider strategic context Describe and apply the tools and techniques for supporting the strategic management of technology Have had experience of creating a technology roadmap
Open innovation Implementation challenges Different OI approaches	Understand what is meant by 'open innovation' and how it contrasts with 'closed' approaches Describe the challenges faced by firms seeking to implement open innovation, and how these challenges can be addressed
Technology intelligence	Describe the importance and challenges firms face in monitoring threats and opportunities from new technologies Understand some of the basic approaches for monitoring the changing technology landscape

Technology acquisition	Understand why/how companies define the scope of their activities, and the link to MvB Apply MvB strategy formulation and decision support methods in technology intensive contexts Develop assessment criteria for the acquisition of early stage technologies
Intellectual property strategies	Appreciate the critical importance of effective intellectual property strategies to maximize value capture from innovation and novel technologies To understand the complexities of IP in the development, diffusion and commercialisation of emerging technologies
NPI simulation - CityCar	Experience the challenges in innovation projects and apply learnings of module lectures
Module review	Be able to summarise the key leanings from the module
Module assessment	Demonstrate understanding of key module concepts

Reading list

Christensen, C. M. (1997). The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Cambridge MA, Harvard Business School Press, ISBN: 0875845851.

Ehrnsperger, J. F. and F. Tietze (2019). "Patent pledges, open IP, or patent pools? Developing taxonomies in the thicket of terminologies." Plos One 14(8): e0221411.

Goffin, K. and R. F. Mitchell (2017). Innovation Management: Effective strategy and implementation Palgrave.

Govindarajan, V. and C. Trimble (2010). The other side of innovation: Solving the execution challenge, Harvard Business Review Press.

Granstrand, O. (1999). The Economics and Management of Intellectual Property: Towards Intellectual Capitalism. Cheltenham, UK and Northampton, MA, USA, Edward Elgar Publishing.

Gregory, M. J. (1995). "Technology management: A process approach." Proceedings of the Institute of Mechanical Engineers 209: 347-356.

Kerr, C. I. V., L. Mortara, R. Phaal and D. R. Probert (2006). "A Conceptual Model for Technology Intelligence." International Journal of Technology Intelligence and Planning 2(1): 73-93.

Moore, G. (1991). Crossing the chasm. New York, HarperBusiness.

Probert, D. (1997). Developing A Make Or Buy Strategy For Manufacturing Business, Institution Of Electrical Engineers

For many of the subjects covered, the Centre for Technology Management's website provides a rich source of readings, e.g.

Technology Roadmapping

<http://www.ifm.eng.cam.ac.uk/roadmapping/>

Technology Intelligence

<http://www.ifm.eng.cam.ac.uk/research/ctm/techintelligence/>

Open Innovation

<http://www.ifm.eng.cam.ac.uk/research/ctm/openinnovation/>

Intellectual property management and strategy

www.ifm.eng.cam.ac.uk/iipm

MET-IIB-4: Manufacturing Systems Engineering / Robot Lab

The module is in two parts: a taught component, followed by an extended practical session.

Module Leader: Alan Thorne

Other IfM staff: Prof. Duncan McFarlane, Simon Sennitt, Chris Jennings, Dr. Greg Hawkridge, Rob Glew

Dates: Taught Component: Monday 11 – Friday 15 November 2019
Practical Component: Monday 18 – Friday 22 November 2019;
Monday 9 – Friday 13 December 2019

Location: Taught Component: Alan Reece Building, Lecture Room 2
Practical Component: Alan Reece Building, Automation Laboratory

Assessment: The module will be assessed entirely on the practical systems build.
The assessment will be based on scheduled interim staff appraisals/technical mark (60%), Technical Report (10%), Pre-Demo Presentation (10%) and Reflective Essay (20%).

Electronic submission at: met-admin@eng.cam.ac.uk

Submission Deadline: Sunday 12th January 2020 - 23:59 GMT

Attendance: Due to the nature of the module, students must have permission before missing the practical component. An Application of Allowance form, signed by your College Tutor, must be submitted to the MET Admin before permission will be given. Absence from practical sessions will result in lower mark being awarded for the module.

Module Learning Outcomes

- Primary: To provide students with the ability to design and build automated manufacturing systems.
- Subsidiary:
 - To provide students with an awareness of the state of the art in certain elements of automated manufacturing technology.
 - To provide experiential learning of managing a complex project, including managing self, managing others and managing time.

Background

The design of manufacturing systems is a key integrating activity for manufacturing engineers and managers. Although manufacturing transformation processes are diverse, the principles involved in building systems are transferable. One needs to define the requirements and plan upfront, to understand the detail of the processes involved, to foresee potential failure modes and plan recovery etc. This module aims to teach students these principles through a mixture of didactic teaching and experiential learning. It is based

around the physical building of an automated machining/assembly system, supported by teaching sessions on planning systems integration, and on elements of automation.

A major theme running throughout the entire module is that of 'learning'. In today's turbulent business environment, companies need to recognise that static solutions are unlikely to provide competitive advantage for long. Arie de Geus, (ex-Planning director for Shell), is quoted as saying that the only sustainable source of competitive advantage is being able to learn faster than the competition. Thus knowing 'how to learn' is an essential skill for engineers and managers, and the activities in the module are devised to encourage students to 'learn how to learn'

Learning objectives

On completion of this module students should:

1. Know and understand the stages of planning and implementing integrated manufacturing systems, including the major pitfalls and how to avoid them.
2. Be able to write a simple functional specification for an automated system.
3. Know the state of the art in CNC machining, robotics, PLC control, and factory communications technology.
4. Understand the basic principles of tool and fixture design for automated operations and be able to design simple fixtures and robot end effectors.
5. Know the different types of sensor used in automation, and understand the importance of their correct application in designing robust systems.
6. Understand the basic principle of machine and cell control.
7. Be able to plan and carry out an assigned automation task and to integrate this with other complementary tasks to deliver a fully functioning system. This involves developing an understanding, and practical experience of:
 - managing projects
 - managing self
 - learning how to learn
 - problem solving
 - communications

Module structure and content

The module will be split into two parts: a taught component, followed by an extended practical session.

The taught aspects of the module are designed to provide the theoretical background and underpinning to the practical work. These will include sessions on planning automation, on the various technologies used in automated systems: CAM/CNC, programmable logic controllers, robotics, sensing, fixture design; and on controlling an automated cell.

The practical aspect of the module is an extended exercise in the Robot Laboratory involving the design and build of an automated system to carry out simple assembly tasks. This is intended to give students hands-on experience of the design and construction of automated systems, and alert them to the types of problem that arise. A major part of this is

experiential learning of the softer skills of project management: managing self and others, communicating, group problem solving and learning.

More detail on the practical aspect is given in a separate booklet which will be issued at the start of the MSE module.

MSE/Robot Lab – Week 1 11 – 15 November 2019 *This is a draft timetable and may be subject to changes*

		Morning		Afternoon	
Monday 11 Nov	09-00 09-15 11-00 12-00	Introduction Planning Systems Integration Introduction to Robot Lab Lab. Safety Talk – H&S questionnaires	Alan Thorne Tim Mead Innometech Ltd. Alan Thorne / Duncan McFarlane Simon Sennitt	14.00- 14:30 17-30	Project Management Systems Robot Lab Planning, definition of groups, selection of managers, specification of performance measures, initial work schedules including Lab tutorials, risk assessments
Tuesday 12 Nov	09-00 – 13-00	Programmable Logic Controllers - PLC Types and Applications - Programming and control -Principles and examples Tutored practical exercises Programming PLCs, Cell Control, interfacing and visualisation	Justin Baker Wayne Corp Omron	14-00 16-00- 17-30	Tutored practical exercises (cont'd) Lab Equipment tutorials
Wednesday 13 Nov	09-00 10-00 - 11-00 - 12-00 – 13-00	Sensors in Automation Fixturing and End effectors Industrial IOT Cell control and system testing Cell Managers to meet with AT/DCM after end of session	Alan Thorne Duncan McFarlane Alan Thorne / Duncan McFarlane		Free
Thursday 14 Nov	09-00 11-00 – 13-00	CNC Machines Tools, FMS and Automated Machining Systems Lecture – Integrated Manufacturing Systems Exercise- Automated component manufacture	Yamazaki Mazak (UK) Mark Hall Mike Sykes	14-00 - 16-00- 17-30	Introduction to Robotics Applications, Methods of Programming, Integration Lab Equipment tutorials
Friday 15 Nov	09-00 – 13-00	Pneumatic Systems in Automation	Stuart Cheyne SMC Pneumatics (UK)	14-00 - 16-00- 17-30	Low cost Automation Lab Equipment tutorials

MSE/Robot Lab – Week 2 18 – 22 November 2019 *This is a draft timetable and may be subject to changes*

		Morning		Afternoon	
Monday 18 Nov	09-00 - 13-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	14.00 - 17-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	
Tuesday 19 Nov	09-00 - 13-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	14.00 - 17-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	
Wednesday 20 Nov	09-00 - 13-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt		Free	
Thursday 21 Nov	09-00 - 13-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	14.00 - 17-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	
Friday 22 Nov	09-00 - 13-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	14.00 - 17-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	

A coffee/tea break will be taken each day at around 11-00am, and 3-15pm.

MSE/Robot Lab – Week 3 9 – 13 December 2019 *This is a draft timetable and may be subject to changes*

		Morning		Afternoon	
Monday 9 Dec	09-00 - 13-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	14.00 - 17-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	
Tuesday 10 Dec	09-00 - 13-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	14.00 - 17-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	
Wednesday 11 Dec	09-00 - 13-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt		Free	
Thursday 12 Dec	09-00 - 13-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	14.00 - 17-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	
Friday 13 Dec	09-00 - 13-00	ROBOT LAB Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt	14.00 - 15-30	ROBOT LAB Presentations in Lecture room Robot lab live running demo	

A coffee/tea break will be taken each day at around 11-00am, and 3-15pm.

Manufacturing Systems Engineering - Syllabus and session learning outcomes

(Note all lecturer material within the MSE module is examinable)

Syllabus	Session learning outcomes
Planning Systems Integration Managing large projects. Stages of planning and implementation. Functional specifications. Typical problems with integration and how to avoid/solve them.	Know and understand the stages of planning and implementing integrated manufacturing systems, including the major pitfalls and how to avoid them. Write a simple functional specification for an automated system. Appreciate and be able to manage the effect of changes during design and implementation.
Introduction to Robot Lab Aims of the practical sessions. Description of the tasks. Organisation and methods of working. Risk assessment. Health and safety considerations. Methods of staff support. Methods of assessment.	Understand the practical task, the methods of operation, and the methods of assessment to be used. Carry out risk assessments, and to install and maintain safe working practices.
CNC Machine Tools, FMS, Automated Machine Systems Types of CNC machine tool. Benefits of multiple axis machines, esp 5,6 axis. Types of tooling and sensing. Automated methods of loading. Minimally manned operation. 'Make complete in one' Machine from solid vs forge/cast and machine.	Know the state of the art in CNC machining and Flexible Automated Manufacturing Systems. Understand current industrial needs, practical applications and automated solutions. Relate automated solutions to business needs.
Introduction to Robotics Types of robots. Benefits of different axis configurations. Types of end effector. Sensing. Software enhancements – soft float, force feedback etc. Vision systems and robotics. Multiple robot systems.	Know the state of the art in robotics. Understand current industrial needs, practical applications and automated solutions. Relate automated solutions to business needs.

<p>Sensors in automation</p> <p>Requirements for sensing in automated systems.</p> <p>Types of sensors.</p> <p>Connecting sensors into systems.</p> <p>Benefits and limitations of different sensor types.</p> <p>Sensor applications.</p>	<p>Know the different types of sensor used in automation.</p> <p>Choose an appropriate sensor, and understand the importance of the correct application of sensors in designing robust systems.</p> <p>Implement sensor technology into automated systems.</p>
<p>Fixturing and end effectors</p> <p>Principles of fixture design.</p> <p>Factors affecting accuracy and repeatability</p> <p>Kinematic location.</p> <p>Methods of clamping.</p> <p>Sensor requirements for fixtures in unmanned operation.</p>	<p>Understand the basic principles of tool and fixture design for automated operations.</p> <p>Design and build simple fixtures and robot end effectors.</p>
<p>Cell control</p> <p>Different approaches to cell control.</p> <p>Centralised and decentralised control systems.</p> <p>Auto-ID technologies.</p> <p>Monitoring and visualisation, SCADA systems.</p>	<p>Understand the basic principles of machine and cell control.</p> <p>Specify a control architecture for a simple automated manufacturing cell.</p> <p>Understand the need for, and how to deal with, mixed product production in automated cells.</p>
<p>Programmable logic controllers</p> <p>PLC vs. PC for cell control.</p> <p>Functionality of modern PLCs.</p> <p>Methods of PLC programming: ladder logic; sequential function charts.</p> <p>Communications and networks, deterministic versus non deterministic;</p> <p>Industrial networks, Devicenet, Ethernet, Profibus etc.</p>	<p>Know the state of the art in PLC control, and factory communications technology.</p> <p>Be able to develop and test simple PLC programmes.</p> <p>Understand the methods of linking PLCs into factory systems.</p>
<p>Pneumatic Systems in Automation</p> <p>Overview of infrastructure components required to deliver pneumatic / vacuum solutions. (Compressors, Dryers, Storage, Regulation)</p> <p>Overview of control and actuation components. (Valves, Regulators, Actuation Cylinders, Grippers, Suckers)</p> <p>Basic component symbology and circuit layouts.</p> <p>Transformational technologies supporting / impacting pneumatic solutions.</p>	<p>Understand what the key components are that would be required in implementing a pneumatic solution in an industrial environment.</p> <p>Basic understanding of control and actuation components that would be required in the controlled operation of a fixture / robot end effector.</p> <p>Use of standard pneumatic circuits and symbology to describe the operation of a pneumatic system. (Clamping components of a fixture)</p>

MET-IIB-5: Industrial Operations Management

Module Leader: Dr Alexandra Brintrup

Other IfM staff: Dr. Ajith Parlikad , Tim Pearce, Dr. Sanyapong Petchrompo, Timos Kipouros, Dr Mohamed Zaki

Dates: Monday 25 November – Friday 29 November 2019

Location: Alan Reece Building, Lecture Room 2

Assessment: Electronic submission at: met-admin@eng.cam.ac.uk

Submission Deadline: Friday 13th December 2019, - 23:59 GMT

Module Learning Outcomes – on completion of the module students should be able to:

1. Appreciate the complex nature of business decision-making and develop a suitable approach to model decisions.
2. Understand and apply data analytics techniques for analysing industrial data to reveal insights for the business.
3. Understand and apply machine learning and artificial intelligence techniques to solve industrial problems.
4. Understand how advanced data analytics and decision-making is transforming industries.

Industrial Operations Management week 1 - 25 November – 29 November 2019 This is a draft timetable and may be subject to changes

Time	Monday 25 Nov	Tuesday 26 Nov	Wednesday 27 Nov	Thursday 28 Nov	Friday 29 Nov
0900-1030	Introduction to module <i>Alexandra Brintrup</i>	Introduction to Optimisation <i>Timos Kipouros</i>	Decision making under uncertainty <i>Sanyapong Petchrompo</i>	Data mining <i>Mohamed Zaki</i>	Risk and Sensitivity analysis <i>Alexandra Brintrup</i>
Coffee					
1100-1230	Sampling <i>Alexandra Brintrup</i>	Multi-objective Optimisation, and Optimisation with Heuristics <i>Timos Kipouros</i>	Decision making under uncertainty <i>Sanyapong Petchrompo</i>	Data mining <i>Mohamed Zaki</i>	Risk and Sensitivity analysis <i>Alexandra Brintrup</i>
Lunch					
1330-1500	Regression analysis, Multiple Regression analysis <i>Alexandra Brintrup</i>	Optimising business decisions – Practical session <i>Alexandra Brintrup</i>	free	Neural networks <i>Timos Kipouros</i>	Discrete Event Simulation <i>Ajith Parlikad</i>
1500-1630	Regression analysis, Multiple Regression analysis <i>Alexandra Brintrup</i>	Optimising business decisions – Practical session <i>Alexandra Brintrup</i>	free	Neural networks <i>Timos Kipouros</i>	Simulating complex systems <i>Alexandra Brintrup</i>

Industrial Operations Management - Session syllabus and learning outcomes

Introduction	Appreciate the range of logical and structured applications of modern data analytics methods and their role in supporting decision making in business
Sampling	Explore the basics of sampling data and appreciate how sampling can be used through a hands on case study.
Regression analysis	Learn to construct single and multiple regression models, and how to interpret model outputs
Optimisation	Learn how to formulate single and multi-objective optimisation problems Understand the range of Heuristic and nature-inspired methods applied to optimization problems.
Optimising business decisions – hands on	Learn how to structure and solve optimisation problems in operations management
Decision-making under uncertainty	Understand how uncertainty and risk influence decision-making Learn different approaches for making decisions under risk (e.g., decision trees) Understand the value of information in decision-making
Data mining	Learn the mechanisms behind Association rule mining, clustering, and classification. Understand which operational problems can these methods be usefully applied.
Neural networks	Learn about the fundamentals of Neural Networks, what problems they are appropriate for, and practice using Neural Networks through a hands-on session.
Risk and sensitivity analysis	Learn a variety of techniques to explore robustness of model results to variations in model parameters, thus assessing risks.
Discrete Event Simulation	Understand the fundamentals of simulating a manufacturing operation Learn how to use Arena to develop a simulation model and analyse the results

Simulating complex systems	Introduce students to complex systems, and demonstrate a number of tools to model and simulate them.
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Reading List

1. Hillier, F.S., *Introduction to Operations Research*, McGraw Hill.
2. Wisniewski, M. *Quantitative methods for decision makers*, Prentice Hall.
3. Russel and Norvig, *Artificial Intelligence: a modern approach*, Prentice Hall.

MET-IIB-6: Leadership and Managing People

Module leaders: Prof Tim Minshall

External speakers: TBC

Dates: Monday 2 December 2019 – Friday 6 December 2019

Location: Alan Reece Building, Lecture Room 2

Assessment: Written assessment of case study

Electronic submission at: met-admin@eng.cam.ac.uk

Submission Deadline: Friday 6th Dec 2019; 23:59 hr. GMT

Module Learning Outcomes

By the end of the module the students will:

1. Appreciate the impact of human factors on business performance and the role of leadership, building on the foundations provided in METIIA.
2. Know the core theories that underpin the management of people and the role of leadership, and the relative strengths and weaknesses of each.
3. Understand the implications of changing business processes on managers and employees, and the role of leadership in different business contexts.
4. Appreciate the range of people-related issues that can occur when implementing change, and have a basic understand of key approaches to change management.
5. Understand the role of people in successful business collaborations and, in particular, issues of trust and contracts.
6. Understand the different types of leadership and the ways in which these can be developed and deployed.
7. Be aware of the messy practical details of leadership and people management.

Managing People - Leadership

2 - 6 December 2019 *This is a draft timetable and may be subject to changes*

Time	Monday 2 December	Tuesday 3 December	Wednesday 4 December	Thursday 5 December	Friday 6 December
0900-1030	Module introduction and assessment briefing. Review of key issues on Managing People. Core theories.	Developing management and leadership capabilities	The practical challenge of managing change in different contexts.	How to have difficult conversations.	Module assessment preparation
Coffee					
1100-1230	Leadership versus management.	Management and leadership in smaller companies.	Managing partnerships.	Case examples: The practicalities of leadership and managing people	Module assessment preparation
Lunch					
1330-1500	Panel Discussion: Why this stuff <u>really</u> matters in different contexts.	Management and Leadership in Multinational Corporations (MNCs).	Free	Module review Module assessment preparation	Module assessment preparation
Tea					
1530-1700	Module assessment preparation	Module assessment preparation	Free	Module assessment preparation	23:59 Deadline for submission of module assessment report

Managing People - Leadership – Session syllabus and learning outcomes

Syllabus	Learning Outcomes
Introduction Assessment briefings	To understand the impact of human factors on business performance and the role of leadership, and to be reminded of key people-related learning covered in MATIIA. To know how this module will be assessed.
Core theories	To be aware of the core theories that underpin the management of people and the role of leadership, and the relative strengths and weaknesses of each.
Panel Discussion: Why this stuff <u>really</u> matters in different contexts.	To appreciate the ‘real world’ importance of this material, and how it will form a major part of most MET graduates working lives.
Developing management and leadership capabilities	To understand the different types of leadership and the ways in which these can be developed and deployed.
Management and leadership in smaller companies. Management and leadership in larger organisations.	To understand the role and tools of management and leadership in large complex organisations and in smaller, early stage organisations.
The practical challenges of managing change in different contexts.	To appreciate the range of people-related issues that can occur when implementing change. To be aware of the different approaches to change management, and the relative merits and weaknesses of each.
Partnerships and people	To be aware of the role of human factors in successful business collaborations and, in particular, issues of trust and contracts.
How to have difficult conversations	How to develop the key management and leadership skill of communicating in ‘difficult’ situations.
Case examples of the practicalities of leadership and managing people	To appreciate the messy practical details of leadership and people management (recruiting, line-managing, promoting, making redundant) through case examples from local manufacturing organisations.

Reading List:

Module readings provided on Moodle.

MET-IIB-7: Production Technologies and Materials

Module Leaders: Dr Ronan Daly, Prof. Bill O'Neill

Other IfM staff: Claire Barlow, Michael de Volder, Sebastian Pattinson, Alan Thorne, Florian Urmetzer, Niamh Willis-Fox.

Dates: Monday 13 January – Friday, 24 January 2019

Location: Alan Reece Building, Lecture Room 2

Assessment: Assignment [40% (10% group presentation, 30% group report)], End of module test [60%]

End of module written assessment
LT2 – Thursday 23 January, exact time to be confirmed.

Electronic submission of group report to:

met-admin@eng.cam.ac.uk

Submission Deadline: Friday 24 January 2020 – 23:59 GMT

Module Learning Outcomes

By the end of the module, the students should (be able to):

- Relate their MET IIA learning to a range of industrial contexts
- Understand/appreciate the range of materials, technologies and processes involved in current best practice manufacturing
- Describe future trends in these areas
- Make appropriate choices of materials and manufacturing processes in a business context
- Relate these choices to product and process design

PTM – Week 1

13 January – 17 January 2020 This is a draft timetable and may be subject to changes

Time	Monday 13 Jan	Tuesday 14 Jan	Wednesday 15 Jan	Thursday 16 Jan	Friday 17 Jan
0900 – 1030	09:00 – 10:00 4 week project choices <i>Frank Tietze</i> 10:00 – 10:30 Module Introduction <i>Ronan Daly, Bill O'Neill</i>	Production technologies: Assembly and Automation <i>Alan Thorne</i>	Advanced processes: Additive manufacturing <i>Sebastian Pattinson</i>	Injection Moulding <i>Florian Urmetzer</i>	Advanced processes: Ultra-precision production technologies <i>Bill O'Neill</i>
10:45 – 12:15	PTM Assignment Introduction <i>Bill O'Neill</i>	Manufacture of Superconducting Magnets <i>Melanie McGregor Siemens</i>	Additive manufacturing systems <i>Chris Sutcliffe (Renishaw)</i>	Biopolymers <i>Claire Barlow</i>	Advanced processes: Laser Technologies <i>Bill O'Neill</i>
1330-1500	Chemical Process Industry & Technologies <i>Ronan Daly</i>	Joining: Adhesive Bonding <i>Stuart Thompson (Huntsman)</i>	PTM Assignment: Group work	Polymer characterisation & advanced applications <i>Niamh Willis-Fox</i>	PTM Assignment: Group work
1515 – 1645	Continuous Manufacturing <i>Andrew Rutter (GSK)</i>	PTM Assignment: Group work	PTM Assignment: Group work	PTM Assignment: Group work	PTM Assignment: Group work

PTM – Week 2

20 January – 24 January 2020 This is a draft timetable and may be subject to changes

Time	Monday 20 Jan	Tuesday 21 Jan	Wednesday 22 Jan	Thursday 23 Jan	Friday 24 Jan
0900- 1030	Carbon fibre composites: material and applications <i>Benjamin Wood (Hexcel)</i>	Aerospace Manufacturing <i>To be announced</i>	PTM Assignment: Group work	Module assessment (9:30 – 10:30)	PTM Assignment - Group presentation (9:00 – 10:30)
Coffee					
1045-1215	Carbon fibre composites: F1 applications <i>Steve Foster (McLaren)</i>	<i>Review of learning outcomes from lectures</i> <i>Ronan Daly, Bill O'Neill</i>	PTM Assignment: Group work	PTM Assignment: Group work	PTM Assignment - Group presentation (11:00 – 13:00)
Lunch					
1330- 1500	Carbon nanotubes and their applications <i>Michael de Volder</i>	PTM Assignment: Group work	PTM Assignment: Group work	PTM Assignment: Group work	Feedback
Tea					
1515-1645	PTM Assignment: Group work	PTM Assignment: Group work	PTM Assignment: Group work	PTM Assignment: Group work	23:59 Deadline for submission of group report

Production Technologies and Materials – Syllabus and session learning outcomes

Syllabus	Session learning outcomes
<p>Chemical Process Industry & Technologies</p> <p>Definition and categorization of chemical process industry</p> <p>Introduction to Continuous and Batch processes</p> <p>Example unit operations</p> <p>Production process design</p>	<p>Appreciate the range of industries linked to chemical processes</p> <p>Understand the choice between continuous and batch manufacturing</p> <p>Develop basic design skills for chemical processes</p>
<p>Continuous manufacturing and advanced technologies in manufacturing</p> <p>Current manufacturing technology in the pharmaceutical industry</p> <p>The drivers for change in manufacturing</p> <p>Unit operations, batch and continuous manufacturing technologies in the pharmaceutical industry</p> <p>Emerging advanced manufacturing techniques</p>	<p>Understand the global challenges facing the pharmaceutical industry and why dramatic changes are needed.</p> <p>Be able to describe the key goals in moving from batch to continuous manufacturing or a mix of batch/continuous manufacturing.</p> <p>Be able to describe a selection of processing techniques for batch and continuous manufacturing.</p> <p>Understand the links between the broader supply chain and manufacturing choices.</p>
<p>Production Technologies: Assembly and Automation</p> <p>The relationship between product characteristics and assembly method: volume/complexity.</p> <p>Overview of different assembly system configurations.</p> <p>The advantage/disadvantages of hard/soft automated systems.</p> <p>Case studies</p>	<p>Make informed choices of assembly system (including automation) components</p> <p>Appreciate the range of additional supporting processes and activities that are needed to implement such a system</p> <p>Justify a choice of assembly automation system taking into account product lifecycle and flexibility requirements.</p>
<p>Advanced processes – superconducting magnets</p> <p>Design, materials selection and manufacturing processes for high-field superconducting magnets for medical imaging applications.</p> <p>Supply chain and quality issues</p> <p>Assembly challenges</p>	<p>Describe the particular logistic, scheduling and technical problems of manufacture and transport of these very large, high precision devices.</p>

<p>Joining – adhesive bonding</p> <p>Chemistry of adhesives and the batch manufacturing routes for their production</p> <p>Background to the application of advanced adhesives</p> <p>Principal applications of industrial adhesives</p> <p>Approaches taken to testing adhesive properties</p> <p>Considerations when choosing between adhesives for different applications.</p> <p>New developments of adhesive technology</p>	<p>Understand the basic operational and manufacturing principles of adhesives</p> <p>Understand the current range of adhesive formulations and areas of application</p> <p>Understand the importance of adhesives to the wider manufacturing industry.</p>
<p>Injection moulding</p> <p>Injection molding basics</p> <p>Machine setup (how do they work?)</p> <p>Forms, flow analysis</p> <p>Potential quality issues</p> <p>Other processes: Bottle blowing and filling</p>	<p>Understand concept of injection molding</p> <p>Comprehend the process of injection molding</p> <p>Appreciate problems with the process</p> <p>Know basic quality aspects</p>
<p>New opportunities in biopolymers</p> <p>Definitions, properties and applications of biopolymers.</p> <p>Environmental issues – examples of life-cycle assessments.</p>	<p>Understand the production, applications and properties of various common biopolymers and the environmental consequences of their use.</p>
<p>Polymer characterization and advanced applications</p> <p>Definitions, properties and applications of advanced polymers</p> <p>Characterisation techniques to interrogate polymer properties</p>	<p>Understand the changing role of polymers in industry.</p> <p>Understand the basics of sampling, measuring and validating polymer materials.</p>
<p>Advanced processes – additive manufacturing</p> <p>Fundamental rapid prototyping concepts for the production of 3D objects, with a focus on polymers and metals.</p> <p>Application in design and production</p> <p>Additive manufacturing concepts and the drive for higher throughput and mass customization</p> <p>Application studies</p>	<p>Understand the basics of additive manufacturing operations.</p> <p>Understand the means by which these technologies can be applied in manufacturing applications.</p> <p>Appreciate the benefits and limitations of additive technologies as compared with standard manufacturing approaches.</p>

<p>Additive manufacturing systems</p> <p>Key techniques for metal additive manufacturing at industrial scale, materials challenges in metal AM</p> <p>Process challenges in metal AM, Industry applications and case studies</p> <p>Future challenges facing broader adoption of AM</p>	<p>Able to describe steps in each production technology noted by Renishaw</p> <p>Understanding the challenges and limitations in metal AM.</p>
<p>Advanced processes – laser technologies</p> <p>Global context of industrial laser manufacturing markets</p> <p>Modern high power industrial lasers and their systems</p> <p>Laser manufacturing across the length scales</p> <p>Principal applications of industrial laser systems</p> <p>Future developments of laser technology</p>	<p>Understand the scale, operation and impact of high power industrial laser systems in the global market place.</p> <p>Understand the means by which lasers can manipulate materials for manufacturing applications.</p> <p>Understand the basic laser based manufacturing techniques and technologies.</p> <p>Appreciate where and how industrial lasers may replace traditional manufacturing technologies.</p>
<p>Ultra-precision production technologies</p> <p>Definition of ultra-precision manufacturing</p> <p>Manufacturing processes at the very small scale, their characteristics and limitations.</p> <p>Build an understanding of a range of micro and nano manufacturing ultra-precision techniques including a range of lithographic, roll-to-roll printing and ion-beam approaches.</p>	<p>Understand the range of micro manufacturing and ultra-precision techniques for processing components from metals, ceramic and polymers.</p> <p>Understand their potential and limitations in manufacturing next generation products</p> <p>Be aware of the choice of manufacturing techniques for different applications</p>
<p>Carbon Fibre Composites – materials</p> <p>Manufacturing process steps when fabricating carbon fibre composites for end applications.</p> <p>Applications for carbon fibre and associated materials for composite structures</p> <p>Development of the composites business and future prospects for CFRP</p>	<p>Appreciate the technological, logistic and economic complexities of CFRP manufacture and use in composite structures</p> <p>Understand the constraints and opportunities for wider application of CFRP</p>
<p>Carbon Fibre Composites – F1 applications</p> <p>Materials selection and design for high performance racing cars</p> <p>Quality assurance and testing</p>	<p>Describe and justify the range of applications of carbon fibre composites and other advanced materials in Formula 1 racing car design.</p>

Process steps when fabricating components from carbon fibre composites	Understand the materials processing methods used and the reasons for their selection.
Carbon Nanotubes and their applications Structure, properties, synthesis and processing of CNTs. Applications and market development Safety	Understand the manufacturing processes, properties and a range of potential applications of CNTs.
Aerospace Manufacturing Trends in manufacturing Industry and market challenges Manufacturing and assembly case study Supply chain challenges Advanced materials and processes Future of manufacturing	Understand the complex supply chain, materials and process challenges of manufacturing and assembling large aerospace designs. Understand the future trends expected in materials and processes as well as the market challenges.

Production Technologies and Materials - Module Assignment

Objective

The purpose of the assignment is to give students the opportunity to experience first-hand the factors affecting the choice of materials and production/assembly method for a variety of products, drawn from a range of industry sectors.

Module Context

During the module, students hear presentations covering alternative approaches to manufacturing components and assembling products, ranging from simple manual assembly methods to fully automated systems based on a variety of architectures. Design for assembly and factors affecting choice of materials and processes are also addressed, along with details about specific materials and production processes across a range of manufacturing industries. The assignment allows the students to apply these ideas to real examples of materials and process choices along with assembly operations.

Assignment Activities and Process

Students are grouped into teams of four or five. Each team is allocated a product that is manufactured at a factory somewhere in the world.

The challenge is for the team to undertake an analysis of the product design, materials choice, the manufacturing system capable of producing it and the business context in which it is manufactured. The results of each project group are presented in a debrief to the class at the end of the module and a submitted report.

Debrief

Each team prepares a 20 minute presentation for the entire class at the end of the module, summarising their analysis and findings. The presentation is assessed based on standard criteria, i.e. were the results presented in a clear and competent way? Was good use made of visual aids? Were the presenters audible, enthusiastic and articulate? Were the technical aspects of the project adequately handled? Were questions well handled?

Report

Each group presents a short report that summarises their findings during the course of the assignment. Electronic copies of the reports are to be submitted by email to met-admin@eng.cam.ac.uk by 23.59 on Friday 24th January

MET-IIB-8. Sustainable Manufacturing

Module leaders: Dr. Daniel Summerbell

Other IfM staff: Prof Steve Evans, Dr Claire Barlow,

Dates: Monday 10 February – Friday 14 February 2019

Location: Alan Reece Building, lecture room 2

Assessment: Written case study assessment

Electronic submission to: met-admin@eng.cam.ac.uk

Submission Deadline: Friday 14 February 2020 – 23:59 GMT

Module Learning Outcomes

By the end of the module students should be able to demonstrate knowledge and understanding of:

- What is meant by sustainability in an industrial context;
- The drivers of and barriers to sustainable manufacturing;
- Systems approaches to sustainability;
- How businesses may respond to the sustainability challenge;
- Carbon footprint assessment of a product using the Eco-audit tool on CES.

Sustainable Manufacturing 10 – 14 February 2019 This is a draft timetable and may be subject to changes

Time	Monday 10 Feb	Tuesday 11 Feb	Wednesday 12 Feb	Thursday 13 Feb	Friday 14 Feb
0900-1030	Module Introduction <i>Dr Daniel Summerbell</i> Industry & Sustainability <i>Prof Steve Evans</i>	Packaging and sustainability <i>Dr Claire Barlow</i>	Sustainable Business Innovation <i>TBC</i>	Case study: Riversimple <i>Prof Steve Evans</i>	Module assessment preparation
Coffee					
1100-1230	Eco-Audit reprise: Carbon Footprint Assessment <i>Dr Hugh Shercliff</i>	Sustainable systems & case study: AB Sugar Wissington <i>Dr Dai Morgan</i>	Sustainable Business Innovation (continued) <i>TBC</i>	Future of industrial sustainability <i>Prof Steve Evans</i>	Module assessment preparation
Lunch					
1330-1500	Energy & Lifecycle Analysis <i>Dr Stuart Scott</i>	Case study: Vitsœ Eco Factory <i>Mark Adams</i>	Free	Module assessment preparation	Module assessment preparation
Tea					
1530-1700	Eco Audit Coursework	Module assessment preparation	Free	Module assessment preparation	23:59 Deadline for submission of module assessment report

Sustainable manufacturing – Session syllabus and learning outcomes

Syllabus	Learning outcomes
	Demonstrate understanding of:
Sustainable Manufacturing in a global context	Implications on resource usage and GHG emissions of manufacturing industry as a whole
Sustainable systems	Long-term sustainability of global industrial systems requires integrated approaches which involve the whole system, rather than looking at different parts in isolation.
Sustainable business innovation	An overview of how businesses can innovate their business models towards sustainability introducing industry proven tools to better understand sustainable value and business transformation.
Eco-Audit: Carbon footprint assessment	Use of CES to estimate carbon footprint of a product, including critical evaluation of limitations of the process.
Energy and lifecycle analysis	The technical and economic viability of different energy sources for global energy supply.
Packaging and sustainability	Using systems approaches to assess the contribution of packaging to carbon footprints in the food industry
Case study: British Sugar, Wissington	Implementation of systems approach to resource efficiency within a large process-industry site.
Case study: Vitsœ	An integrated approach to sustainability within an SME.
Case study: Riversimple	How a start-up company used a blank sheet of paper approach to find innovative solutions to traditional mobility problems

Reading list – Sustainable manufacturing

- ALLWOOD, J.M., *Sustainable materials – with both eyes open*
CULLEN, J. Available as download from the web
<http://www.withbotheyesopen.com/read.php>
- ASHBY, M.F. *Materials and the environment*, Butterworth-Heinemann 2012, ISBN 978-01-23859716
- ESTY, D.C., WINSTON, A. *Green to gold: how smart companies use strategy to innovate, create value and build competitive advantage*. John Wiley, 2009
- HAWKEN, P., LOVINS, A.B., LOVINS, L.H. *Natural capitalism: the next industrial revolution*. Earthscan publications, 1999.
- LACY, P., RUTQVIST, J. *Waste to Wealth: The Circular Economy Advantage*. Palgrave Macmillan, 2015
- MACKAY, DJC *Sustainable energy – without the hot air*, www.withouthotair.com, 2008
- McDONOUGH, BRAUNGART M *Cradle to cradle*, Northpoint press 2002
- VON WEISZACKER E, LOVINS A.B., LOVINS L.H. *Factor Four: doubling wealth, halving resource use*. Earthscan publications, 1997
- YANG, M., EVANS, S., VLADIMIROVA, D. and RANA, P. [Value uncaptured perspective for sustainable business model innovation](#) 2017. Journal of Cleaner Production, 40 (3), 1794-1804

Industrial Projects

Introduction

Industrial projects are a distinctive feature of MET IIB and are a key element both for teaching and assessment. The aims of the industrial projects are to:

1. provide an experiential learning opportunity to support and extend the theoretical aspects of the taught modules;
2. develop a firmer understanding of the problems and difficulties associated with the application of taught material and concepts in an industrial setting;
3. allow you to practice the skills of managing yourself and others: project planning; time management; seeking, identifying and classifying critical information from mass data; co-operation and influencing others;
4. enable you to appreciate the importance of good communication, both formal and informal, and to practice the skills of evidence-based report writing and business presentations.

Projects Timetable

The projects are structured to expose you to problems of increasing complexity, and with increasingly unspecific objectives and methodological guidance. The time allocated to each project also increases as the programme progresses. The intention is that this sequence of projects will provide a structured transition from the academic to the industrial setting. The project sequence is as follows:

Induction Project (3 days)	Groups of 7-8 students	Mapping processes, the flow of materials and knowledge in a factory
Michaelmas Term (2 week project)	Groups of 2 students	Addressing company problems principally of a technical nature
Lent Term (4 week project)	Groups of 4 students	Addressing a range of substantive company issues, spanning all aspects of manufacturing operations
Easter Term Long project (7 (1+6) weeks)	Individual	Very wide variety of briefs within the MET definition of manufacturing

Attendance

Due to the nature of Projects attendance is compulsory. Requests for absences from projects should be emailed to MET Admin before the project starts and must include an Application for Allowance form signed by your College Tutor.

The Induction Project

The Induction Project serves as an introduction to the industrial projects component of MET IIB focusing predominantly on manufacturing process and shop floor operations. It is assessed in the same way as all following MET IIB industrial projects, but the marks do not contribute to the overall degree performance.

Aims

The aims of the Induction Project are to:

- i. introduce you to the key functions in a typical manufacturing company;
- ii. enable you to practice the skills of evidence gathering, analysis, interpretation and collation;
- iii. enable you to practice the interpersonal and project management skills necessary to work as part of a team towards a specific time constrained objective.
- iv. provide a first non-assessed experience of MET IIB style project work.

Project Operation

The overall objective of the Induction Project is to chart the flow of (i) information and (ii) material in a manufacturing company, typically focused on one manufacturing process.

Setting up the projects

The projects run in companies, each selected by a University Supervisor. The company and the University Supervisor agree a detailed brief for the student group, appoint an Industrial Supervisor with overall responsibility for the project, and a contact person for each team.

Project implementation

The student group allocated to a company assume joint responsibility for the project. They work in teams of 2-4 on specific sub projects related to different parts of the company; taken together the sub projects cover a substantial part of all main areas of the company.

Responsibilities

A **Group Leader** is appointed by each student project group to be responsible for co-ordinating all arrangements. This includes ensuring that all relevant areas of the company are examined.

The **University Supervisor** makes pre project arrangements with the company; briefs students before the project; is available for contact during the project and attends the final presentation.

An **Industrial Supervisor** has overall responsibility for the project and appoints a local contact person for each sub task team.

Project Reporting

Oral presentation to the company.

This normally takes place on the final afternoon of the project to an audience consisting of senior staff within the company, and the University Supervisor.

All students are expected to contribute in some way to the presentation, but getting everyone to speak might not be an effective use of time. The total time for the presentation, including all sub-projects, should not be more than about 45 minutes, and will be followed by questions.

These will come from the company staff rather than the University Supervisor: the presentation is for the benefit of the company rather than for the supervisor.

Written report

The report needs to be submitted by **23:59 on Sunday 13 October** following the project.

Each team of students responsible for each sub-report produces a separate report.

The report should follow the structure and layout detailed in Appendix 3 and particular attention should be paid to a coherent chain of arguments leading to your conclusions, the use of appropriate and properly documented evidence and analysis as well as the style, clarity and format. It should start with an Executive Summary of 1 page giving both the overview of the tasks for the whole project group and the tasks for the respective team who have written the particular report. Each team needs to be aware of what the other teams have done, and ensure that the conclusions and recommendations are consistent. This will be checked by the University Supervisor.

During the week following the project the University Supervisor holds a supervision with each team and gives detailed feedback on performance. During the supervision students are asked for their perceptions of the company.

Modifications to the report may be necessary following the supervision. The final version must be handed in by **23:59 on Tuesday 22 October** following the supervision, and will be checked by the supervisor before being sent off to the company.

Assessment and supervision

The induction project is assessed for each student individually using the assessment form shown in the appendix in the same way as the other projects forthcoming later in the programme, but the marks do not count towards the final degree: the feedback is intended to ensure students are properly calibrated for subsequent projects.

Timetable 2019

- Projects: 9 October to 11 October.
- Company presentation: Afternoon (possibly late morning) 11 October.
- Reports (pdf) to be emailed to MET Admin: **before** 23:59 Sunday 13 October. NOTE: only electronic copies are required.
- Supervision with academic supervisor: by end of Friday 18 October.
- Revised reports (including revisions requested by supervisor) emailed to MET Admin by 23:59 Tuesday 22 October.
- Reports sent to companies by Friday 25 October.

Two-week & Four-week projects

Agreeing projects

The Induction Project and the Two-Week and Four-Week Projects are set up by MET staff, who agree project briefs with companies. For the Two-Week and Four-Week Projects a list is made available in advance and supervisors introduce the projects in a class meeting approximately two weeks before the project start date. Students are encouraged to state preferences and every effort is made to accommodate their wishes.

Project supervision

For all group projects a University Supervisor is appointed who is responsible for:

- i. agreeing the project with the company;
- ii. preparing a project brief which includes a statement of the project objectives, some background and guidance on how to proceed;
- iii. visiting the company during the project period to discuss progress with the students;
- iv. attending the final presentation to the company, and providing confidential feedback to students;
- v. marking the end of project report;
- vi. providing feedback on the report so that it can be modified before being sent to the company.

In each case a Company Supervisor is also appointed to look after the day-to-day running of the project in the company.

Confidentiality

Companies may require students to sign a confidentiality / non-disclosure agreement prior to the start of the project. Students are strongly advised to strictly adhere with the regulations set out in the agreement. In such case the University Supervisor will guide the students through that process supported by the university's contract team. Students **must not** sign any such agreement given to them by the company without consulting the University Supervisor.

Project execution

Working with company staff to complete projects to tight deadlines requires considerable tact and presence – and this is one of the key learnings from the course. The following guidelines should be observed:

- i. students are subject to the same local rules and conditions as any other employee;
- ii. students should work at least the normal working hours;
- iii. a detailed programme of work should be drawn up at least by the second day;
- iv. regular review meetings for the team should be timetabled, even if they are in regular contact with each other;
- v. all information that is used in the project must be substantiated by evidence – hearsay is not acceptable;
- vi. interviews with members of the company are best limited to 30 minutes. It is better to arrange a series of short interviews than to make a major interruption to the interviewee's schedule;

- vii. factual information should be recorded as the project proceeds, in a form suitable for inclusion in the final report (make use of appendix);
- viii. students are expected to use evenings for report writing and presentation preparation.

Project deliverables

The Two Week and Four Week Projects are not artificial exercises: they are aimed at solving real, current problems in the company and the results are important to them. The company managers and University Supervisors will expect two deliverables:

1. An end of project presentation

This is particularly important to the company and is normally made to senior members of the operations and management team. The University Supervisor also attends as the presentation is an integral part of the student assessment. The presentation forms part of the assessment. The presentation normally includes 30 minutes of presentation and 15 minutes of questions. High standards of organisation, structure, use of evidence, delivery and visual aids are expected.

2. A project report

This is both a more formal feedback to the company and the basis of assessment of student performance by the University. It is intended to ensure that the need for the project, the work done (incl. use of evidence and systematic approach / analysis), the results and recommendations are all fully documented. The report should be a stand-alone document containing sufficient information to give a newcomer to the project all the information they need to pick up the project and continue it. It may well happen that the reports are distributed across the company to people, who were not involved in the project. Requirements for MET IIB report style is given in Appendix 3 of this handbook.

In addition to the above it might also be appropriate to produce a handover file for the company, giving additional information that the company needs to fully understand what the project team has done. This might include fuller explanations, contact addresses, supplier brochures, computer printouts etc.

Project report submission procedure

- i. At the time of the final presentation students should agree with the University Supervisor a date for a project supervision in Cambridge. At this supervision there is a general review the project experience and feedback from the supervisor on the project report.
- ii. Before leaving the company the students should leave a full set of the presentation slides with their company host and not take with them any sensitive data that belongs to the company.
- iii. The project report must be emailed to met-admin@eng.cam.ac.uk by the due date. If a hand-over file is produced this must be handed in at the same time so that the supervisor has a full appreciation of what has been achieved.
- iv. The MET Teaching Office staff will forward the files to the University supervisor for comment and marking.
- v. The project supervision, and any amendments to the report must be completed before the final submission deadline. **The original report, including supervisor's comments, and the amended report must be handed in by this deadline.**

vi. The MET Teaching Office staff send the amended report and handover file to the company for comment. If their comments require further modification to the report it will be returned to the students. **Modifications must be made and the reports returned for final printing and distribution within seven days.** Details of all hand in dates are given in the section entitled “Project Report Hand-In Dates 2019-2020”.

Please read the following carefully.

- i. Reports must be in the MET standard report format – see example given in the Appendix 3 of this handbook. Reports in any other format are not acceptable. A template for this style is available on Moodle.
- ii. Everything in the report should be capable of being photocopied in black and white through an automatic feeder. Please note, black and white printing is still standard in many organizations. Students are responsible for supplying additional copies of any material which do not meet this criterion.

Project Assessment

Assessment of industrial project work is based on effectiveness in meeting objectives, systematic evidence-based investigation and quality of presentations and reports, with appropriate allowances for difficulty of task and level of support provided by the host company.

All projects will be marked independently by the University Supervisor and another MET staff member, who then will agree on the marks. In Appendix 2 of this handbook are examples of marking forms used by the University Supervisor for each type of industrial project that show the weighting given to each element of the project. Students receive written feedback from their supervisor via CamCORS.

NOTE: The assessment is made on the first report version, not the corrected version.

Late submission

A key feature of industrial project work is adherence to timescales and deadlines. To reinforce this there will normally be automatic penalties for late submission of reports as follows:

Submission	Penalty
Penalty for lateness:	20% of marks per week or park week that the work is late

The only exception will be when written authorisation is given by the University Supervisor and submitted to the MET Teaching Office staff BEFORE the due date, or in extreme circumstances with the written agreement of the MET IIB Course Director.

Project Feedback

Feedback on the project experience is important so that both individual student performance and the project processes can be improved. The University Supervisors will provide feedback to the students based upon input provided by the Company Supervisor, observations of the presentations made during the project, and the final report.

The Long Project

The Long Project is a substantial piece of work which students undertake individually during a six week period in the Easter term. A preparation and scoping week is also timetabled towards the end of Lent term. **In contrast to the other projects, which are organized by University Supervisors, students themselves are responsible for developing, planning and organizing their Long Project.**

Long Project requirements

The Long Project can take many forms and a wide range of options is available, but there are some essential requirements as follows:

- i. projects must include a substantial 'manufacturing' content. In this context manufacturing is taken to mean the very wide definition adopted by the IfM and used as a basis for MET teaching;
- ii. projects must be completed by individuals and not by groups as with earlier projects;
- iii. the project must be a clearly defined piece of work, usually aimed at solving a specific problem. Projects often arise from previous work done by a company but the starting point and boundaries of the student's work must be clear. It must be possible to demonstrate exactly what the student has contributed;
- iv. projects must be agreed in consultation with the University Supervisor and the company contact;
- v. projects typically consist of a detailed scoping study undertaken in the preparation week towards the end of the Lent term, a data gathering and analysis phase, some degree of solution generation, results leading to implementation or trialled implementation;
- vi. the scoping study must be agreed with the Company and University Supervisor and will include:
 - assessment of the subject area to determine key issues requiring investigation;
 - preparation of a project brief including background, objective and approach to be taken;
 - preparation of a project time line (GANTT chart).

Agreeing Long Project topics

In contrast to the 2- and 4-week project, the long projects should be essentially developed by the students themselves. It is thus the students' responsibility to find and develop their own projects. However, MET staff may make suitable projects for students to choose available from on a Moodle page. Students will be introduced to the project selection process.

To develop projects effectively, students should consult with MET academic staff at the earliest opportunity. Staff can help to generate a viable project, e.g. choosing an appropriate subject area, making sure there is enough academic content to satisfy the course requirements as well as doing something worthwhile for the company.

The IfM website can help you to identify staff members with research interests related to the proposed project, or any staff member can be consulted for advice. IfM has many links to companies in UK and abroad and students are encouraged to use this expertise.

Students have to indicate on their Long Project Preference Questionnaire if they plan to pursue an own (i.e. self-developed) project or pick-up a topic provided by a supervisor. All projects need to be agreed with the MET IIB Director (Tim Minshall) and Projects Coordinator (Frank Tietze) by 20th January 2020. Subsequently, all proposals will be reviewed by an internal committee, which will approve project or come back to students asking for adjustments.

After projects have been approved students should ensure to start making arrangements for the preparation week. Students should contact their company to agree the time they will be spending on the company site during the preparation week as well as the university supervisor early to arrange a meeting early in the preparation week.

Long Project report and assessment

Reporting and assessment arrangements are not exactly the same as for shorter projects. The key differences are as follows:

- i. *Length of Report:* Long project reports are expected to convey more information, and more detailed information, than short project reports, so they should be more carefully structured and written. The report should therefore be as long as is necessary to include everything which is relevant. However, length does not correlate with quality. It is usually more challenging to keep reports short. A typical report length would be 40-50 pages (excluding references and appendices).
- ii. *Report Scope:* The project report must be complete in itself and not refer to or rely on a separate hand-over document. This means that it should convey a complete picture of the project to someone who has not been involved in it. For example, someone in the company should be able to pick up the report and use the material, or another student should be able to follow on the project from where it leaves off.
- iii. *Assessment:* As with previous projects, long projects are graded twice - by the University Supervisor and by an Assessor, who will be another experienced MET project supervisor. The Assessor's only contact with the project is through the report, so their most important contribution is commenting on how well the report functions as a 'handover document'.

Long Project timetable

The table on the following page indicates the sequence of events and key actions to set up the Long Project.

Long Project Timetable

21st October 2019	Students introduced to the Long Project Timetable. Students briefed on scope and requirements for projects. Students begin search for potential project topics. Students meet potential long project supervisors.
11th November 2019	Students return questionnaires (form 1) to IfM Teaching Office outlining their interests and ambitions for the long project. Preliminary allocation of supervisors by project coordinator.
9th December 2019	Students to return protocol form (form 2) summarizing the meeting with the supervisor. The form needs to be signed by the supervisor.
13th January 2020	Long Project briefing, topics covered will include: review of timetable, review of supervisor list. Preliminary list of student projects is drawn up continuously.
20th January 2020	Submission of project proposal form (form 3) and cut-off date for student self-selection of projects. Students without a suitable project will subsequently be assigned a project.
TBA/ February 2020	Long project preparation week briefing session
9th March 2020	Start of preparation week. By the end of the week students should have agreed a detailed project brief incl. Gantt chart type of project visualization with university and company supervisors.
13th March 2020	Submission of project brief to Teaching Office.
30th April 2020	Projects start
5th June 2020	Last day for project presentations.
7th June 2020	Long Project report submission in electronic form to Teaching Office and Supervisor.

Professional Conduct

MET IIB is designed as a transition from academic study to professional practice. This is reflected both in the style and content of the taught modules and in the significant focus given to industry projects and company visits. Students should remember that they are representing the University of Cambridge and the Institute for Manufacturing and at all times behave in a professional manner. The guidelines below should be observed.

Dress Code

Students should be smartly turned-out and appropriately dressed for industrial projects and visits. Men should normally wear jacket and tie; a suit can be the easy option. Sensible shoes should always be worn (no high heels, sandals or trainers); other requirements may be specified by the company. During industrial projects it may be acceptable, after initial visits, to adopt a different dress code if this is the norm for the company.

Safety

On all industrial visits and projects safety is paramount. You should pay particular attention to the following:

- i. Safety precautions and notices must be observed at all times and great care should be taken to remain vigilant;
- ii. Safety glasses will be issued for industrial visits and should be worn whenever appropriate. In some companies, ear protectors or protective clothing will also be necessary;
- iii. On entering a company for the first time students should acquaint themselves with any specific hazards and safety requirements. Normally companies will provide a safety briefing, but if they fail to do this then students should specifically ask for guidance. It is essential that before going onto a factory floor students are aware of hazards and have appropriate protection equipment;
- iv. **If students have any doubts on matters to do with Health and Safety they must stop work immediately and contact their Company and University Supervisors. Students should at all times remember they have a statutory duty to comply with all Health & Safety legislation;**
- v. A “Health and Safety on Industrial Projects” checklist is given in Appendix 2 which should be used on every project and visit.

Confidentiality

All information gained on visits and projects must be regarded as ‘company confidential’. Such information should not be disclosed outside MET without the express permission of the companies concerned. The only exception to this is information that is already in the public domain. The marking process is treated as an internal examination process and thus strictly confidential. For the industrial projects some companies usually ask students to sign confidentiality agreements, which should be strictly followed. Students however must not sign any agreement without consulting the University Supervisors.

Intellectual Property Rights (IPR)

Companies own the right to use all the work completed on industry projects. Students may not, without the agreement of the company, use or reveal outside the company any new ideas, designs or concepts developed during a project. They might be asked to sign a confidentiality agreement, but even without one this code of practice must be respected.

Ethical Guidelines

Behaviour

Students should demonstrate the highest standards of ethical behaviour at all times. As a minimum this means students should:

- i. make every effort to perform the project to the best of their ability;
- ii. discuss and agree working arrangements with the organisation and make them aware of their movements and whereabouts;
- iii. be sure to keep appointments and be punctual;
- iv. notify the company and the University supervisor if there are any periods of illness.

Information

Students who are required to collect information from other organisations should declare their association with the University **and** with the host company before asking for the information.

If information is provided in confidence, either by the host organisation or by other organisations, that confidentiality must be respected. The information must not be revealed to anyone else.

If any provider of information asks to see the project report, permission should be sought from the host organisation. If permission is granted the University Supervisor should also be informed.

Dubious situations

Students in any doubt about the ethicality of an action they are considering or are being asked to perform should consult their University Supervisor. If concerns remain they should contact the Project Organiser (Frank Tietze), or the MET IIB Course Director (Tim Minshall).

Company visits

Visits are made to selected companies during the year, covering a wide range of industrial sectors. They are chosen to illustrate aspects of the teaching modules, and students should observe and record the key features of each visit in a structured manner. Credit will be given in the examinations for using relevant examples when answering questions.

MET visits are regarded as a significant event by the host organisation - not just "another visit" – and considerable time and effort goes into their organisation. Students should respond accordingly and behave in an appropriate manner. It is important to keep close to guides to ensure that all the important questions are answered, and preferably only once!

Visit groups should **always plan to arrive** at companies **at least 10 minutes before any scheduled appointments**. In the event of any unavoidable delays the company should be contacted by telephone as far ahead as possible.

Report Writing

Reports are required following all project periods, and are used as the basis for assessment. Reports are also a key feature of professional practice. It is easy for good work to have less impact than it deserves because of poor presentation so the development of appropriate report writing skills is critical. The following points are given for guidance.

Length

- i. Reports should be crisp and concise, with a minimum of lengthy description.
- ii. Short project reports should not normally exceed 4,000 words for the main body – appendices and handover files can be extra.
- iii. Long Project reports are often longer because they must be stand-alone documents. These reports usually have a length of 40-50 pages (excluding references and appendices).

Style

- i. Complex information is usually best presented in the form of charts and diagrams with the source of data always to be made transparent.
- ii. Bullet points and lists are often preferable to prose paragraphs.
- iii. Always use the third person impersonal or reported speech. For example:
"We found that it was possible to..." should read: *"The team found that it was possible to..."* or: *"It was found possible to..."*
"For the rest of the report we shall refer to this substrate as..." should read: *"For the rest of the report this substrate will be referred to as..."*
- iv. Avoid "chatty" vocabulary and abbreviations such as "won't", "can't", "didn't"
- v. Always aim to be precise in your wording. Avoid imprecise expressions such as "some projects", "many processes", "a few people". It is much better to specify a range, even though it is often easy to be precise.
- vi. Think about how the report will be used: the whole report, including charts and diagrams, must be capable of being fed through the automatic sheet feeder on a black and white photocopier. Multi-coloured charts and complex fold-outs will not be helpful.

Structure

- i. Plan the structure of the report before starting to write to ensure clarity and the logical development of ideas and arguments. Briefly list headings and sub-headings. Project teams should do this in the middle of the second week of a two week project, and during week two or three of a four week project.
- ii. Start the report with a one page executive summary.
- iii. The report needs to clearly convey the chosen approach, why it has been chosen and state all relevant data, how it was collected and how it was analysed.
- iv. Use appendices for supplementary data that if presented in the main body of the report would interrupt the flow of the argument. Keep appendices to a minimum: include only relevant material essential for substantiating the report. Other material should be included in the handover file.
- v. List the contents of a hand-over file in an appendix to the main report.

Referencing

Completely referencing any data, evidence, prior studies used in the project is part of professional practice. The use of a referencing software, such as Mendeley, Zotero, Endnote is strongly advised.

Checking

- i. Always run a spell check on the whole report.
- ii. Always check for poor grammar, misplaced or omitted words, and errors such as their/there.
- iii. Always check for layout. For example, do not leave a 'hanging heading', i.e. the title of a section hanging at the bottom of a page with text starting on the following page: put the heading over the page also so that the text carries on from it. Make sure also that figures remain with their captions.
- iv. Proof read the report one more time with a view, not to its content, but to its grammar, punctuation and spelling. If the report was written with a partner, read each other's contribution and criticise or discuss. Really **read** what you have **written**. The most fool proof way to make sure what you have written makes sense is to read it aloud. This may sound silly but it works.
- v. When reading the report through, ask yourself: "Does it flow well?" If not, swap a few clauses around.

Summary

In general the report should be structured, clear and concise, and ensure that the need for the project, the work done, and the results and recommendations are all fully documented with all prior information, data and evidence properly referenced. This includes the proper documentation of all evidence, references, sources of information, contacts and analysis, etc. Sometimes it might be helpful to compile a separate handover documents, such as a manual for using a specific piece of software developed during a project.

Further information

A sample project report is given in Appendix 3 of this document, and report templates are on the MET IIB Moodle site.

Making Project Presentations

The final oral presentation of project work is particularly important for the host company and an essential part of the student's individual assessment. Senior members of the company as well as the University Supervisor will attend final presentations. It is essential therefore that these sessions are well organised and professionally run.

The project teams are responsible for local arrangements in each host company and they should establish the availability of senior staff as early as possible in the project, so that a timetable for presentations can be agreed.

The following tips are given for guidance:

- i. **Length:** Oral presentations should be concise and carefully planned. Short project presentations are normally scheduled to be 45 minutes in length: not more than 30 minutes of presentation, and at least 15 minutes of questions. Long Project presentations are sometimes longer.
- ii. **Visual aids:** These can often make a point more quickly and clearly than extensive descriptions. High standards in the production of visual aids are expected. PowerPoint or similar has become the norm. Project teams should make arrangements during the first week of the project for getting hold of presentation equipment in good time, and ensuring they know how to use it. Project teams will be expected to that the company is left with a copy of the presentation.
- iii. **Structure:** Presentations should be clearly structured. It is particularly useful to provide the audience with a structure slide at the beginning of the presentation so that the logical progress of the presentation will be apparent. It is helpful for the Q&A session if the slides have page numbers. It is advisable to make sure that different sections of the presentations link well together.
- iv. **Review:** The final event of the presentation day will normally be a review by the University Supervisor and the project team without company representatives present. This session provides an opportunity for discussion not only of each team member's performance and the nature of the assignment, but also of company co-operation. A standard form is available for course members to report on the project and host company.

Accommodation and Expenses

The IfM Teaching Office covers the costs for accommodation and travel for the induction, two- and four week projects. However, there is no budget to assist with the Long Projects. Accordingly, the companies hosting students for Long Projects are expected to cover these costs.

Booking Accommodation

For the induction, two- and four-week projects accommodation arrangements are made by the IfM Teaching Office. Reservations are made for the nights of Sunday to Thursday inclusive of each project week, in hotels or guest houses. Bookings will be made on a bed and breakfast basis only: students are free to make their own arrangements for other meals. **No 'extras' will be paid for by the University;** the bill for phone charges, etc. should be settled personally on departure.

Student Guidelines

It is vitally important to maintain good relations with hotels and guest houses. The following guidelines should therefore be strictly observed:

- i. If for any reason students are unable to take up their reservation they should inform the IfM Teaching office as far ahead as possible. Cancellations at short notice are both expensive for the University and annoying for proprietors and can result in a cancellation charge. Students will be asked to pay the cancellation charge personally if it arises from negligence or thoughtlessness.
- ii. Students should ensure that on the first night of a booking (usually the Sunday), they arrive **before 9 p.m.** If, for some **unavoidable** reason, such as transport breakdown, the arrival is delayed the hotel should be contacted and a revised time indicated.
- iii. Every effort is made to select comfortable and hygienic accommodation. However, if the accommodation is totally unsatisfactory and the students are unable to sort out the problems amicably with the proprietors, they should phone or email the IfM Teaching Office as soon as possible.
- iv. To help with future planning students should use the student feedback form to comment on the accommodation.
- v. Students should remember at all times that they are very visible members of the University of Cambridge when staying away and there are those who are quick to point out any shortcomings of conduct or behaviour!

Payment

Hotels are asked to send bills to the University for payment. Students should never be required to part with money directly, unless specifically asked to do so by the IfM Teaching Office. They should sign the bill on departure if asked to do so.

Subsistence

A daily allowance is made to cover the *extra* cost of eating away from Cambridge. This figure is calculated on the *difference* between the cost of College food and the cost of reasonable meals bought commercially. Subsistence claims must be made separately, within 30 days of the end of each project period, using the University Expense Forms which can be found on Moodle. **You must include receipts for any expenses you are claiming: No receipt = No payment.** It is also sensible to make a photocopy of your receipts in case of any queries.

The daily allowance is £9.00. This is allocated at **£3.00 for lunch and £6.00 for dinner**. The "usual" claim is from Sunday evening to the Friday afternoon - i.e. five dinners and lunches per week.

Students should only claim money actually spent; if a company provides lunch, for instance, **no claim should be made**.

There may be occasions when it is not possible to arrive back in Cambridge at the end of the week before 19:00-19:15. In **these instances only**, dinner allowance for that Friday evening may be claimed.

Claiming

Submission of all documentation together greatly reduces the administrative burden imposed on the IfM Teaching Office by project work. Ideally, claims for expenses should be submitted to the IfM Teaching Office at the same time as the final report. The claim forms can be found on Moodle.

Three very important points to remember:

- 1. All claims must be supported by receipts.**
- 2. Any claim submitted more than six weeks after the expense has been incurred will not be refunded.**
- 3. Students must not enter into any financial arrangements without checking with the IfM Teaching Office. There are set procedures required by the University that cannot be breached.**

Travel arrangements

Introduction

MET has the use of a fleet of IfM vehicles for transporting students and staff to company projects and visits. The vehicles have comprehensive insurance cover when driven by accredited drivers on authorised course business only. **Under no circumstances should the vehicles be used on private business.**

Accredited drivers

Students and staff may volunteer to be drivers of the course vehicles and may be accredited if they satisfy the following conditions:

- i. have passed a university approved MiDAS driving test.
- ii. hold a full driving license, in force for at least two years.
- iii. have no driving convictions (excluding one speeding offence).
- iv. are over 21 years of age.
- v. have not been involved in any motor accidents in the past three years, either as the innocent or guilty party.

Responsibilities of drivers

The three **essential** responsibilities of drivers are:

- i. to drive with due care and attention, with the safety of their passengers in mind at all times;
- ii. to comply with the requirements of the law and the Highway Code;
- iii. to pay due care and attention to the condition of the vehicle in their charge.

In addition drivers have the following operational responsibilities to:

- Collect the vehicle log book, keys and fuel purchase card from the IfM Teaching Office, normally during the afternoon of the working day before the start of the journey.
- Check basic safety items at the beginning of each journey and regularly thereafter. This applies to oil and water levels, brakes, steering, lights, and tyres.
- Report any vehicle deficiencies to the IfM Teaching Office immediately.
- Record in the log book details of each day's journey and any maintenance problems.
- Maintain a good standard of cleanliness in the vehicle.
- Purchase fuel as necessary using the card and PIN provided. Vehicles should be returned with the fuel tank full.
- Park the vehicle tidily on return to the West Cambridge carpark. Under no circumstances may vehicles be parked away from this site when in Cambridge.
- Return the vehicle log book, keys and fuel card to the IfM Teaching Office, reporting any problems verbally as well as noting them in the log book.

- To pay personally the fines for any driving offence e.g. speeding, parking or seat belt fines.
Under no circumstances will the university pay or refund the cost of such penalties.

Repair and Maintenance

- i. Routine maintenance and servicing is organised by the IfM Teaching Office.
- ii. Emergency work necessary while the vehicle is away from Cambridge must be authorised by the IfM Teaching Office. Arrangements will normally be made for invoices to be sent to the university.
- iii. Reimbursement of the cost of essential small purchases for maintenance should be claimed on an expenses claim form. Receipts must be submitted to support all claims.

Accidents and Breakdown Emergencies

Vehicles have a recovery membership, details can be found in the Log Book. All accidents should be reported immediately to the IfM Teaching Office or Simon Pattinson (07879 845716) and if appropriate to the Police.

Alternative Transport

- i. If, by prior agreement with the IfM Teaching Office only, public transport is used as an alternative to the normal fleet of vehicles the costs agreed in advance will be reimbursed. The costs will normally include bus, coach or student rail fare.
- ii. Taxi's cannot be refunded without prior agreement with the IfM Teaching Office.
- iii. Expenses will not normally be paid for travel within Cambridge i.e. within a 3 mile radius of Great St Mary's Church.
- iv. Use of rental cars may sometimes be necessary when the IfM cars and minibuses are unavailable. The IfM Teaching Office will organise this with a local firm, but it will be the responsibility of the named designated driver to collect and return the vehicle as required under the agreement made with the car hire firm. In this case, you will have to pay for any fuel and claim payment back from the IfM Teaching Office as fuel cards will not be valid for a hire car.

Contacts

For all routine matters relating to vehicles, please contact the IfM Teaching Office.

In out of hours emergencies the contact is Simon Pattinson (07879 845716).

The Overseas Research Project (ORP)

Aims

The aims of the Overseas Research Project (ORP) are to:

- i. expose students to a broad cross section of current practice in international manufacturing;
- ii. experience in an integrated manner the application of the course material in a range of industrial settings;
- iii. enable the students to practice project management and team working skills;
- iv. expose students first hand to the importance of stakeholder management.

ORP Process

When: The ORP takes place during a two week period following the end of the Easter term. Some preparation time is allocated within the MET IIB timetable but most of the work is extracurricular.

Who: A staff member is appointed in an advisory/ supervisory role but the project is organised and delivered by the MET IIB students as a group.

How: The MET IIB students are responsible for identifying a research location and topic (in discussion with the MET IIB Director and relevant MET staff and researchers), arranging visits to companies, coordinating with MET Administrator to arrange travel and accommodation and for securing sponsorship to fund the ORP. Due to tightened budgets, the Engineering Department is not in a position to provide finance for the ORP. However, the IfM Teaching Office will provide matched funding of £50 for each student, subject to each student contributing an equal amount.

Reporting: The key deliverables from the project are a report on the identified research theme and a presentation at the IfM. Students are responsible for the detailed content of the report, though this must be signed off by the MET IIB Director prior to dissemination.

Assessment: The ORP itself is not assessed but parts of the background research may be used as examples in the synoptic examination papers.

VERY IMPORTANT

All financial transactions relating to the ORP must be discussed with the MET Administrator before you make any commitments. The University has very strict rules on how money is received and paid out.

Before committing to any financial arrangements, you must check with the MET Administrator to make sure you do not inadvertently break any University finance rules.

Key actions and timings

When	What
By the end of MET IIA	<p>Appoint the student project leader and three team members responsible for sponsorship, research and logistics respectively.</p> <p>Agree the research location. Plan B is essential.</p> <p>Outline the research topic or options.</p>
Over the summer break	<p>Continue planning.</p> <p>Keep MET IIB Director, MET Administrator, Mukesh Kumar and IfM-ECS Communications Officer informed of developments.</p>
By start of Michaelmas term	<p>Identify and contact potential sponsors.</p> <p>Develop a refined statement of the research topic.</p> <p>Draft the project brochure for sending to sponsors and companies, in discussion with IfM-ECS Communications Officer.</p>
As early as possible	<p>Confirm the outline of the programme.</p> <p>Identify target companies for visits.</p> <p>Negotiate timing of visits to companies.</p> <p>Confirm with the MET IIB Director who from IfM will be accompanying the tour.</p>
Preparing the Project Report	<p>Much of the report should be prepared before the tour. This should certainly include the literature review, and the research questions and methodology. The structure of the final report should also be clear.</p> <p>During the tour it is important to have daily reviews of the visits, and for individuals to be responsible for writing up the results of each visit.</p>
Following the tour	<p>Immediately on return from the tour students should complete the project report, which must be signed-off by the MET IIB Director before publication.</p> <p>IfM-ECS Communications Officer will be able to assist with the dissemination of the report.</p> <p>A presentation summarising the report should be arranged as part of the IfM Friday Seminar Series (coordinated by Dr Yongjiang Shi)</p>

Appendix 1:

Penalties for late hand in of coursework or missing the Robot Lab or Projects
There are automatic penalties for late submission of any piece of coursework or project report. The penalty will be 20% of marks per week, or part week, that the work is late.

There are automatic penalties of marks deducted for missing days of the Robot Lab or Projects without prior approval.

Coursework extensions requested prior to the hand in date, and notification of missing Robot Lab or Projects, or any mitigating reasons for a late hand in or a missed day of Robot Lab or Project, must be accompanied by a METIIB Allowance form signed by your college tutor. An Allowance form can be obtained from the IfM Teaching Office (met-admin@eng.cam.ac.uk)

Reasons for arranging coursework or missing the Robot Lab or Projects

Reasons for seeking to rearrange course work or missing an Industrial Visit fall into one of the following five categories:

Illness

Educationally it is always preferable to rearrange coursework missed through illness, and this should be attempted wherever practicable. If rearrangement is not possible, then students should apply for the appropriate allowance.

'Illness' is broadly defined as any illness, mental health problem, physical injury or other grave cause which, in the opinion of both the student's tutor and the METIIB Course Director, prevents the student from completing their scheduled coursework activities on time, or in some cases at all.

Compassionate or religious grounds

Students will, wherever practicable, be allowed to rearrange coursework, or miss Robot Lab and projects, on compassionate or religious grounds (for instance, to enable them to attend a funeral, or because the coursework is scheduled on the day of a religious festival). The student concerned should try to rearrange the coursework in advance. If rearrangement proves impossible, then an application for an allowance may be made with the support of the student's tutor.

Interviews

When applying for jobs, work placements or sponsorship, students may be invited for interview on days that conflict with coursework activities and visits. Students should in the first instance seek to rearrange the interview rather than the coursework or visit. If this proves impossible, then the student should try to rearrange the coursework. Allowances are not normally given for coursework missed through interviews. For a missed industrial visit, an application for an allowance may be made with the support of the student's tutor.

Sporting commitments

Robot Lab and projects may **not** be rearranged to accommodate **College** sporting commitments. Students will, wherever practicable, be allowed to rearrange coursework that conflicts with **University** sporting competitions (i.e. representing the University of Cambridge in a competitive event) but not for training sessions. For a missed industrial visit, an application for an allowance may be made with the support of the student's tutor.

Guidance on Referencing, Collaboration and Plagiarism

1. The confidence which a reader has in the contents of a report, paper or dissertation is based on trusting the author. An important contribution to building that trust is through the author demonstrating clearly how they have built on the work of others (including company internal reports and ideas), and giving full credit to previous contributions, as well as identifying unambiguously which parts of the overall work are their own, original contribution. That is the role of references in technical writing: to give recognition to other people's work and to provide an 'audit trail' of links to previous work. Developing a good style of referencing takes some effort: in many cases, facts and ideas are so well known and standard that no reference is needed, but if you have doubts about whether the reader might misinterpret the extent of your own contribution you should always refer explicitly to the source of any previous work.
2. In some of your work you will collaborate with other students. Not only does this often make sense in terms of splitting up a larger task into smaller parts, but it can also be a very fruitful method of generating new ideas. Learning how to manage and work within a collaborating team forms an important part of your training as an engineer. In some cases work which results from a team effort will be assessed for examination credit. In such cases all authors of the work must be clear among themselves as to which parts have been contributed by each member.
3. If a report contains material of which you (or in the case of a collaborative report, a member of your team) are not the originator, then you must make the origin of the material explicitly clear by suitable references (including company specific internal data or reports). Not to do so constitutes plagiarism, which is defined as '*submitting as your own work material which derives in part or in whole from the work of others without due acknowledgement*'. Wherever you use sources of information or data such as books, journal articles, internal company sources, personal interviews, web-sites, internal company material or other internet resources you should ensure that they are fully referenced, so that the reader can locate the source and if necessary make an independent judgement of the quality of the information. You should only include text which you have not generated yourself if it is clearly marked as a quotation (e.g. by placing it in quotation marks with a full reference to its source).
4. Plagiarism is both poor professionalism / scholarship and breach of academic integrity, and is regarded extremely seriously within the University. Plagiarism is a form of cheating and any incident in work assessed for examination credit will be reported to the Head of Department, who will normally refer the matter to the University Proctors.
5. Forms of plagiarism include copying someone else's language and/or ideas as if they are your own by, for example, quoting verbatim, paraphrasing, cutting and pasting from the Internet, or submitting someone else's work as part of your own without full and explicit acknowledgement of the source. Plagiarism applies to all types of sources and media, whether published or not (i.e. company specific internal reports).

6. The guiding principle is that Examiners and others who may read your work must be in no doubt as to which parts of it are your own original work and which parts are the work of others, or have been produced by you in collaboration with others.
7. These guidelines apply to all assessed work: for example, coursework and project reports.
8. Further guidance can be found in the statement of the University's Policy on Plagiarism at www.admin.cam.ac.uk/univ/plagiarism. If you are uncertain about these guidelines or have any questions about their application, the Director of Undergraduate Teaching, or in the case of MET the Course Director, will be glad to provide advice.

University of Cambridge General Board Statement on Plagiarism

The General Board, with the agreement of the Board of Examinations and the Board of Graduate Studies, has issued this guidance for the information of candidates, Examiners and Supervisors. It may be supplemented by course-specific guidance from Faculties and Departments.

Plagiarism is defined as submitting as one's own work that which derives in part or in its entirety from the work of others without due acknowledgement. It is both poor scholarship and a breach of academic integrity.

Examples of plagiarism include **copying** (using another person's language and/or ideas as if they are a candidate's own), by:

- **quoting verbatim** another person's work without due acknowledgement of the source;
- **paraphrasing** another person's work by changing some of the words, or the order of the words, without due acknowledgement of the source;
- **using ideas** taken from someone else without reference to the originator;
- **cutting and pasting** from the Internet to make a pastiche of online sources;
- **submitting someone else's work** as part of a candidate's own without identifying clearly who did the work. For example, buying or commissioning work via professional agencies such as 'essay banks' or 'paper mills', or not attributing research contributed by others to a joint project.

Plagiarism might also arise from **colluding** with another person, including another candidate, other than as permitted for joint project work (i.e. where collaboration is concealed or has been forbidden). A candidate should include a general acknowledgement where he or she has received substantial help, for example with the language and style of a piece of written work.

Plagiarism can occur in respect to all types of sources and media:

- text, illustrations, musical quotations, mathematical derivations, computer code, etc;
- material downloaded from websites or drawn from manuscripts or other media;
- published and unpublished material, including lecture handouts and other students' work.

Acceptable means of acknowledging the work of others (by referencing, in footnotes, or otherwise) vary according to the subject matter and mode of assessment. Faculties or Departments should issue written guidance on the relevant scholarly conventions for submitted work, and also make it clear to candidates what level of acknowledgement might be expected in written examinations. Candidates are required to familiarize themselves with this guidance, to follow it in all work submitted for assessment, and may be required to sign a declaration to that effect. If a candidate has any outstanding queries, clarification should be sought from her or his Director of Studies, Course Director or Supervisor as appropriate.

Failure to conform to the expected standards of scholarship (e.g. by not referencing sources) in examinations may affect the mark given to the candidate's work. In addition, suspected cases of the use of unfair means (of which plagiarism is one form) will be investigated and may be brought to one of the University's Courts. The Courts have wide powers to discipline those found guilty of using unfair means in an examination, including depriving such persons of membership of the University.

The University's plagiarism and good academic practice website (www.cam.ac.uk/plagiarism) provides more information and guidance.

Student information on the use of Turnitin

The University subscribes to Turnitin UK software which is widely used in UK universities and matches text in work submitted to the software to that in a large database of online sources. This document explains how Turnitin UK will be used by the Department of Engineering and explains the implications of submitting your work to the software.

You are reminded that Turnitin is only one method of checking the originality of your work. Examiners may initiate the standard investigative procedures if they have unresolved queries about the originality of your work, regardless of whether Turnitin has been used or whether it has substantiated any concerns.

The University Advocate may decide to prosecute a student suspected of plagiarism even where that student has not consented to the use of Turnitin. In such circumstances the student may be specifically asked by the Advocate to consent to submission to Turnitin and a failure to consent will be proved as part of the evidence against him or her.

Plagiarism and good academic practice: your responsibilities

You should also familiarise yourself with the statement on plagiarism which is appended to this document. This statement is posted on the University's plagiarism website www.cam.ac.uk/plagiarism which also features links to useful resources and guidance.

If, after reading the guidance, you have any outstanding queries you should seek clarification at the earliest opportunity from your Director of Studies or supervisor.

About Turnitin UK text-matching software

Who controls the service?

Turnitin UK is part of the JISC Plagiarism Advisory Service (JISCPAS). This University is the recognised Data Controller for the data held and processed by, or on behalf of, the service. An American company, iParadigms, is the Data Processor.

How does Turnitin UK work?

Turnitin UK may detect direct plagiarism, paraphrasing and collusion as submitted work is compared with a vast database of online material and with a 'private' database of previous

submissions. Therefore, submitting work to the database helps to protect it from future attempts to plagiarise it, and helps to maintain the integrity of the University's qualifications. The software makes no judgement about whether a student has plagiarised, it simply shows the percentage of the submission that matches other sources and produces an originality report which highlights the text matches and, where possible, displays the matching text and its immediate context.

In many cases the software highlights correctly cited references or 'innocent' matches. Therefore, Examiners will carefully review all originality reports to determine whether the work does contain plagiarism.

How will Turnitin UK be used in the Manufacturing and Management Division, Department of Engineering?

Work submitted for assessment in the Manufacturing and Management Division, Department of Engineering will be subjected to spot checks from time to time, or in cases where there is cause for concern. Students should note that, upon screening work, the resulting originality reports will be referred only to the Examiners responsible for the academic assessment of the work if there is *prima facie* evidence of plagiarism or poor academic practice. Work must be submitted electronically.

What will happen if matches are identified between my work and another source?

If Turnitin UK detects matches between your work and another source, the Examiners will review the resulting originality report to judge whether the matches are innocent, or whether you have appropriately referenced these matches (if not, this may constitute plagiarism), and/or whether you have made excessive use of material from other sources (which may be poor academic practice).

The Examiners will mark your work purely on the basis of its academic merit. However, depending on the extent and context of the matches, your work may be referred to the Proctors for further investigation. In such cases the Turnitin UK originality report may be used as evidence. If you are found to have plagiarised the penalty may be severe and your degree may be withheld.

Will Turnitin UK affect my intellectual property rights or copyright?

The copyright and intellectual property rights of the submitted material remain wholly with the original owner (normally the student, with the exception of some collaborative or sponsored research projects). However, you are asked to permit Turnitin UK to:

- reproduce your work to assess it for originality;
- retain a copy of your work for comparison at a later date with future submissions.

Will my personal data be retained by Turnitin UK?

Material submitted to Turnitin UK will be identified by your examination number, course details and institution: personal data will not be used.

What will happen if text submitted by another student matches that in my work?

Matches to text submitted from other HE institutions

If a report generated by another institution identifies a match to your work the report will only show the extent of the match and the contact details of the University's Turnitin UK Administrator. If approached, the Turnitin UK Administrator will attempt to contact you about the matter. The contents of your work will not be revealed to a third party outside Cambridge without your permission.

Matches to text submitted from within the University

If a match is found to material submitted from within the University, the Examiners can obtain the full text without approaching you.

How do I apply for my work to be removed from Turnitin UK?

Work submitted to Turnitin UK will be stored indefinitely on the Turnitin UK database unless you specifically request that it be removed. To maximise the effectiveness of the software it is hoped that such requests will be kept to a minimum. However, once examinations have been concluded, you may at any time contact [the Department's Turnitin UK contact] to request that your work be removed.

Sources of further information and support

The University's plagiarism website:

www.cam.ac.uk/plagiarism

Department's plagiarism advice:

<http://teaching.eng.cam.ac.uk/node/526>

Turnitin UK's website:

<http://www.turnitinuk.com>

CUED Information and Library Services

The library team at the Department of Engineering is available to help with any questions you may have about resources, search strategies and managing references.

A member of the team is based at IfM on Friday mornings, or you can visit them in the CUED Library in the Baker Building, Trumpington Street.

Contact them at 01223 332626 or cued-library@eng.cam.ac.uk

Judge Business School: Information and library services

The Business Information Centre is located in the left-hand wing on the ground floor of the Judge Business School building.

Opening Hours

Term-time:

Mon-Fri	08.45-18.00
Weekends	Closed

Vacation:

Mon - Fri	09.00-17.00
Weekends	Closed

Registration

Please register at the Information Centre desk when you first visit. You will need to present your University card and your email address.

Printed Resources

The Information Centre's printed collection includes core texts on Judge Business School reading lists, together with general research texts and journals. You may place reservations on books that are on loan and renew books that are not reserved by other users. Fines are charged for overdue items at 50p per day. You may borrow a maximum of 5 items.

Electronic Resources

Electronic resources are housed on the CJBS Information Blog (<http://www.blogs.jbs.cam.ac.uk/infolib/>) and a linked portal (for which you will need to use your Raven password) which can be accessed wherever you are in the world. Databases available:

- ABI Inform Complete
- Business Insights
- Business Source Complete
- Capital IQ
- Factiva
- Fame
- Global Insight
- Key Note
- Passport GMID
- Thomson One Banker
- WRDS (Compustat, CRSP, I/B/E/S & RiskMetrics)

In addition to the resources on the blog, we provide access to Bloomberg and Datastream on terminals in the Information Centre.

Staff and Contact Details

Please contact us by if you have any enquiries about our service:

Email: infolib@jbs.cam.ac.uk, Tel: 01223 339599

Appendix 2: Sample MET IIB Forms

Induction Project – University Supervisor Project Assessment	83
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Industrial Project – Company Supervisor feedback form.....	87
Health and Safety on Industrial Projects.....	88
Allowance form for missing days of Project / Robot Lab.....	x

Induction Project – University Supervisor Project Assessment

NOTE: Percentage marks for class boundaries are indicative only.

MANUFACTURING ENGINEERING TRIPoS					
Confidential MET IIB (Induction) Industrial Project Assessment					
Student: _____ Assesed By: _____ Date: _____					
Marking boundaries Projects should be marked so that the overall mark is in line with the following class boundaries. Bottom of Class 1 - 70% (excellent) Bottom of Class 2.1 - 60% (good) Bottom of Class 2.2 - 50% (fair) Bottom of Class 3 - 40% (poor) Fail - Less than 40%					
It is expected that, for a set of projects the mean mark should fall within the range of 65 – 70%. Around 25% of projects might be expected to gain more than 70%. Very few projects are expected to score below 50%. Mark each category out of 100.					
<table border="1" style="margin-left: auto; margin-right: 0;"> <tr> <td style="background-color: #f2e0bd; width: 15%;">Supervisor's Mark (%)</td> <td style="background-color: #d9ead3; width: 15%;">Assessor's Mark (%)</td> <td style="background-color: #c6e2fa; width: 15%;">Agreed Mark (%)</td> </tr> </table>			Supervisor's Mark (%)	Assessor's Mark (%)	Agreed Mark (%)
Supervisor's Mark (%)	Assessor's Mark (%)	Agreed Mark (%)			
A. Success in Meeting Objectives <i>How well have the stated objectives been met, taking into account the difficulty of the task and the timescale of the project? How were the results of the project received by the "client"?</i>					
Comments: _____					
B. Quality of Project Approach <i>Was the project tackled in a professional manner? Were appropriate analytical tools used? Were the technical aspects of the project adequately handled? Were there any novel ideas or approaches?</i>					
Comments: _____					
C. Oral Presentation of Results <i>Were the results presented in a clear and competent way? Was good use made of visual aids? Was the presenter audible, enthusiastic and articulate? Were questions well handled?</i>					
Comments: _____					
D. Structure and Style of Report <i>Was the report well-structured and written in clear, understandable English? Were the departmental Guidelines adhered to? Were the style and structure appropriate for a technical report? Were the sections and subsections logically organised? Was there a good summary? Was appropriate use made of appendices?</i>					
Comments: _____					
E. Report Content <i>Did the report convey a full and accurate 'picture' of the project? Did it contain a thorough description of the relevant methods and justify their selection, as well as analysis and the relevant supporting data? Were the boundaries of the project and all relevant assumptions clearly identified? Were there systematically derived recommendations and sensible conclusions?]</i>					
Comments: _____					
Overall Mark (Weight factors as shown) $(0.3xA) + (0.2xB) + (0.15xC) + (0.15xD) + (0.2xE)$ <i>(This sheet will be kept confidential – i.e., it is not copied to students or companies.)</i>					
Supervisor's mark % 0.00					
Agreed mark % 0.00					

Two Week Project – University Supervisor Project Assessment

NOTE: Percentage marks for class boundaries are indicative only.

MANUFACTURING ENGINEERING TRIPoS					
Confidential MET IIB (Two-Week) Industrial Project Assessment					
Student:					
Assesed By:					
Date:					
<p>Marking boundaries Projects should be marked so that the overall mark is in line with the following class boundaries. Bottom of Class 1 - 70% (excellent) Bottom of Class 2.1 - 60% (good) Bottom of Class 2.2 - 50% (fair) Bottom of Class 3 - 40% (poor) Fail - Less than 40%</p>					
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Supervisor's Mark (%)	Assessor's Mark (%)	Agreed Mark (%)			
<p>A. Success in Meeting Objectives <i>How well have the stated objectives been met, taking into account the difficulty of the task and the timescale of the project? How were the results of the project received by the "client"?</i></p> <p>Comments:</p> <div style="border: 1px solid black; height: 40px; margin-top: 5px;"></div>					
<p>B. Quality of Project Approach <i>Was the project tackled in a professional manner? Were appropriate analytical tools used? Were the technical aspects of the project adequately handled? Were there any novel ideas or approaches?</i></p> <p>Comments:</p> <div style="border: 1px solid black; height: 40px; margin-top: 5px;"></div>					
<p>C. Oral Presentation of Results <i>Were the results presented in a clear and competent way? Was good use made of visual aids? Was the presenter audible, enthusiastic and articulate? Were questions well handled?</i></p> <p>Comments:</p> <div style="border: 1px solid black; height: 40px; margin-top: 5px;"></div>					
<p>D. Structure and Style of Report <i>Was the report well-structured and written in clear, understandable English? Were the departmental Guidelines adhered to? Were the style and structure appropriate for a technical report? Were the sections and subsections logically organised? Was there a good summary? Was appropriate use made of appendices?</i></p> <p>Comments:</p> <div style="border: 1px solid black; height: 40px; margin-top: 5px;"></div>					
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<p>Overall Mark (Weight factors as shown) $(0.3xA) + (0.2xB) + (0.15xC) + (0.15xD) + (0.2xE)$ <i>(This sheet will be kept confidential – i.e., it is not copied to students or companies.)</i></p>					
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0.00	0.00				

Four Week Project – University Supervisor Project Assessment

NOTE: Percentage marks for class boundaries are indicative only.

MANUFACTURING ENGINEERING TRIPOS						
Confidential MET IIB (Four-Week) Industrial Project Assessment						
Student:						
Assesed By:						
Date:						
Marking boundaries Projects should be marked so that the overall mark is in line with the following class boundaries. Bottom of Class 1 - 70% (excellent) Bottom of Class 2.1 - 60% (good) Bottom of Class 2.2 - 50% (fair) Bottom of Class 3 - 40% (poor) Fail - Less than 40%						
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Supervisor's Mark (%)	Assessor's Mark (%)	Agreed Mark (%)				
A. Success in Meeting Objectives <i>How well have the stated objectives been met, taking into account the difficulty of the task and the timescale of the project? How were the results of the project received by the "client"?</i>						
Comments:						
B. Quality of Project Approach <i>Was the project tackled in a professional manner? Were appropriate analytical tools used? Were the technical aspects of the project adequately handled? Were there any novel ideas or approaches?</i>						
Comments:						
C. Oral Presentation of Results <i>Were the results presented in a clear and competent way? Was good use made of visual aids? Was the presenter audible, enthusiastic and articulate? Were questions well handled?</i>						
Comments:						
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Comments:						
Overall Mark (Weight factors as shown) $(0.25xA) + (0.3xB) + (0.1xC) + (0.1xD) + (0.25xE)$. <i>(This sheet will be kept confidential – i.e., it is not copied to students or companies.)</i>						
Supervisor's mark %	Assessor's mark %	Agreed mark %				
0.00	0.00	0.00				

Long Project – University Supervisor Project Assessment

NOTE: Percentage marks for class boundaries are indicative only.

MANUFACTURING ENGINEERING TRIPOS								
Confidential MET IIB (Long) Industrial Project Assessment								
Student: _____ Assesed By: _____ Date: _____								
<p>Marking boundaries</p> <p>Projects should be marked so that the overall mark is in line with the following class boundaries.</p> <p>Bottom of Class 1 - 70% (excellent) Bottom of Class 2.1 - 60% (good) Bottom of Class 2.2 - 50% (fair) Bottom of Class 3 - 40% (poor) Fail - Less than 40%</p> <p>It is expected that, for a set of projects the mean mark should fall within the range of 65 – 70%. Around 25% of projects might be expected to gain more than 70%. Very few projects are expected to score below 50%. Mark each category out of 100.</p>								
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Supervisor's Mark (%)	Assessor's Mark (%)	Agreed Mark (%)						
<p>A. Success in Meeting Objectives</p> <p><i>How well have the stated objectives been met, taking into account the difficulty of the task and the timescale of the project? How were the results of the project received by the "client"?</i></p> <p>Comments:</p> <div style="border: 1px solid black; height: 80px; margin-top: 10px;"></div>								
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Supervisor's mark %	Agreed mark %							
0.00	0.00							

Industrial Project – Company Supervisor feedback form

CAMBRIDGE UNIVERSITY ENGINEERING DEPARTMENT
MANUFACTURING ENGINEERING TRIPoS
Industrial Project – company supervisor's feedback

Host Company:	Location:		
Project Title:			
Company Supervisor:	University Supervisor:		
1. Please comment on the presentation of results. Is the report clear, structured, accurate and well presented?			
2. Please comment on how the project team approached the project. Were the investigations sound? Did they develop a 'feel' for the job?			
3. Please comment on the way the project was implemented. How well were the objectives met? Were the results useful to the company?			
4. Additional comments			
I confirm that unless indicated below the report is in no way confidential and that a bound report is not required			
Report is confidential	<input type="checkbox"/>	Bound report required	<input type="checkbox"/>
Signed..... Company supervisor	Date.....		
University Supervisor's response			

Institute for Manufacturing

Briefing Notes for Industrial Project Sponsors

Manufacturing Engineering Tripos

The final two years of a four-year Engineering Masters degree that prepares students for an accelerated career in manufacturing industry

Aims

- *Provide industry with highly motivated and effective potential managers, capable of accelerated promotion*
- *Equip course members with the technical skill, personal development and industrial experience they need to be immediately effective in their early careers in industry*

Programme

The programme develops the practical skills needed to manage in a modern manufacturing environment. Course members gain:

- *Experience of solving industrial problems through three in-company projects totaling 13 weeks work. These are designed to reinforce the material covered in the teaching programme and provide experience in different company environments*
- *Knowledge of manufacturing from a fundamental level to the best practices adopted by leading companies. This is achieved through programme of lectures, teaching workshops and industrial visits*
- *A comprehensive and structured exposure to a wide range of manufacturing operations environments, visiting up to 100 different companies in the UK and overseas*

Course outcome

The course is designed to do more than develop knowledge and skills. The exposure to challenging situations through industrial project work re-inforces a 'can-do' attitude and fosters self-reliance. The teaching programme, followed by the practical application of knowledge, demonstrates to the students that blending theory with existing best practice solves real problems. Working with all levels of employees, from shop floor to boardroom, the students learn the importance of teamwork and leadership in order to obtain solutions in an industrial environment

Health and Safety

MET students are given health and safety briefing at the start of the course. The following safety checklist and reminders of Section 7 & 8 of the health and safety at work Act 1974 are given as guidance for the company H&S briefing at the commencement of a project. Specific company policies and hazards will also need to be included.

PROJECT PLACEMENT SAFETY INDUCTION CHECKLIST		
1	MEANS OF FIRE EVACUATION FROM WORK/BUILDING	
2	FIRE EVACUATION AND ASSEMBLY POINTS	
3	LOCATION OF FIRE ALARM CALL POINTS AND EXTINGUISHERS	
4	FIRST AIDER AND FIRST AID FACILITIES, ACCIDENT REPORTING	
5	PERSONAL PROTECTIVE EQUIPMENT WHERE USED (WITH INSTRUCTIONS WHERE REQUIRED). DUTY TO REPORT ANY DAMAGE, LOSS OR DEFECTS OF ISSUED ITEMS TO LOCAL SUPERVISOR	
6	HOUSEKEEPING, TOILET FACILITIES, LOCATIONS WHERE EATING AND DRINKING ARE PERMITTED	
7	OBSERVATION OF SAFETY SIGNS e.g. NOISE AREAS, SAFETY SPECS etc	
8	TRANSPORT MOVEMENT ON SITE e.g. FORK LIFT TRUCKS	
9	KNOWN LOCAL SAFETY HAZARDS APPLICATION TO A PROCESS OR PROCEDURE	
10	CHECK IF RELEVANT RISK AND C.O.S.H	
11	PERMITS TO OPERATE/WORK WHERE APPLICABLE	
12	IF THERE IS ANYTHING ABOUT HEALTH AND SAFETY LEFT IN DOUBT THEN ASK – NEVER ASSUME	

Under section 7 and 8 of the Act all employees have the duty as follows

Section 7

(a) It shall be the duty of every employee while at work to take reasonable care for the health and safety of himself and of other persons who may be affected by his acts or omissions at work; and

(b) as regards any duty or requirement imposed on his employer or any other person by or under any of the relevant statutory provisions, to co-operate with him so far as is necessary to enable that duty or requirement to be performed or complied with.

Section 8

No person shall intentionally or recklessly interfere with or misuse anything provided in the interests of health, safety or welfare in pursuance of any of the relevant statutory provisions.

It is important that you ensure all items on the checklist and any other local health and safety concerns are explained to and understood by the students. In particular, please emphasise item 12.

Mobile Phones

The students are away from a fixed base for 13 weeks of the course and can often be in a different bed and breakfast every week. They therefore tend to use mobile phones as a method of keeping in contact with family, friends and each other. If this is likely to interfere with equipment or cause offence to other workers please ask them to turn the phones off during working hours.

Use of Computers

Many of the students use their own laptops. To avoid problems with viruses they are asked to conform to the following rules:

- Express permission must be obtained, preferably in writing, before touching any workstation/PC belonging to the company
- No computer is to be taken on site without prior permission, preferably in writing, of the company
- Mobile storage devices during the project must be supplied by the company
- No computer games are to be activated or played with whilst on the company site. This even applies even to games that are on the company's own system
- Anti-virus programmes are not foolproof. It is up to the students to exercise rigid hygiene when using their own or the company's computers

Thanks

Finally, MET would like to thank you for hosting a project team. The course has run very successfully over many years and the high level of ability displayed by its graduates would not have been achieved without the help of many companies who have freely given their time and resources.

For further information

Please contact:

MET Office

Institute for Manufacturing

ifm-enquiries@eng.cam.ac.uk

<http://www.ifm.eng.cam.ac.uk/met/>

Phone: +44 (0)1223 766141

Students must make every effort to contact staff in advance of the visit. E-mails should be copied to the IfM Teaching office met-admin@eng.cam.ac.uk.

Manufacturing Engineering Tripos - Application for Allowance for missing day/days of Projects / Robot Lab

Student Name:	College:	CRSID:
---------------	----------	--------

Request for allowance for missed day/days of Robot Lab					
Date/Dates being missed	Robot Lab or Project		Date staff member contacted	Reason for missing visit	MET response

Request for allowance for missed day/days of Induction / 2 week / 4 week Project					
Date/Dates being missed	Robot Lab or Project		Date staff member contacted	Reason for missing visit	MET response

Tutor's name:	e-mail:	Phone:
---------------	---------	--------

This section to be completed by the student's TUTOR (NOT DoS)

Nature of illness or extenuating circumstances:			
-------------------------------------------------	--	--	--

Dates between which work was impossible		Dates between which work was hindered:	
Additional comments (attach separate letter if you wish) <i>Please enclose doctor's certificate if period affected was more than 7 days</i>			

Signature of Tutor	Date	Signed (MET Course Administrator / METIIB Director / Project Coordinator / Robot Lab Coordinator)	Date
--------------------	------	---------------------------------------------------------------------------------------------------	------

Return completed form to: IfM Teaching Office, IfM, 17 Charles Babbage Road met-admin@eng.cam.ac.uk

Decisions will be made by the METIIB Course Director, in conjunction with MET Course Administrator/Robot Lab Coordinator / Project Coordinator.

Appendix 3: MET Report Template and Style Guide

An example of the layout and style required for an MET project report is given on the following pages.



UNIVERSITY OF
CAMBRIDGE

Institute for Manufacturing

Report Title in this box

Report Number: MET/## - ## - ##

Company Name

Supervisor: Supervisor's name

Author Name #1

Author Name #2

Author Name #3

Author Name #4

Author Name #5

Date

Executive Summary

The purpose of the Executive Summary is to provide a succinct overview of the project. It should be brief enough that even the busiest executive will feel able to scan it, but complete enough to provide a complete picture of the project. It must never be more than one page in length. In it, you should summarise:

- The aims of the project;
- Your main conclusions;
- Your action points.

You can use bullets, which help to keep it short and to emphasise the points you particularly want to get across. But, reading pages full of bullets is tiresome, and so prose should be used wherever possible.

Remember that hardly anyone (except the Cambridge and the Industrial project supervisors) will sit down and read the project cover-to-cover. Most people will pick it up to read your words of wisdom on a particular topic, and if you are very lucky they may read the executive summary or the conclusions as well.

The implications of this for the way you write the report are:

- Some repetition is desirable. Your conclusions and recommendations may appear up to three times: in the executive summary; in the section from which they derive (where full explanations will be given), and in the conclusions section at the end of the report.
- Each section should be quite self-contained, with an introductory sentence or paragraph outlining what will be covered, and conclusions and recommendations relating to the section.

Authors names

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In word, you can create a table of contents automatically, providing you have used appropriate 'styles' for section headings. But this is not fool proof, and very often the list is wrong. ALWAYS check this to ensure it is correct.

When you make changes to a document, if the contents page is automatic, then you must 'update field' in order to change it.

1.0 Introduction (Heading 1, Bold, Calibri 12pt, 0pt before, 6pt after)

This document describes the standard formatting required for all reports to be submitted. This must be adhered to. The easiest way to do this is to download and use this template as provided in Moodle.

The body text of the report is written in 12pt Cambria, with 3 points before and 6 points after each paragraph. Line spacing is 1.5. This is the NORMAL font style.

1.1 Report title page (Heading 2, Bold, Calibri 14pt, 12pt before, 6pt after)

The report title should be visible through the hole in the front cover. There should be no page number on the title page. Page numbering starts at 1 with the executive summary.

On the title page, should be the report title, the author's names and where appropriate the supervisor's name and the company name. The submission date should also be included.

1.2 Each section should be initialed

The student who wrote each part of the report must be identified (e.g. initials in pencil by each section).

2.0 Guidance on formatting

The way you structure the content for the main part of the report will vary depending on the project. A project which focuses on a narrow set of issues may call for results to be presented in one large chapter, with subsections. Alternatively, you may want to have several shorter chapters. Use your common sense, and discuss with your supervisor if in doubt.

Typical content would include:

- Company Background: A brief description of company: size, location, sector, important features of operation etc. (Bulleted List, Cambria, 12pt, 3pt before, 6pt after, 1.5 line spacing).
- Description of project: What is it that is trying to be achieved
- Why is the project being done?
- What does the company want to achieve?

- Bulleted List:

The report needs to be as brief as possible, but must convey the important messages to the company. Deciding what should be included and what can be left out is a very important part of the whole report-writing process.

The guideline of 4000 words means that you must be selective, and use your judgement. Experience shows that a report which is longer than this benefits from being cut. This results in a report which is better focused and better thought-through, which is more likely to be read, and hence more likely to be useful.

2.1 Subsection

Use subsections when they are a sub-part of the main argument being made in the main section. The margins for all sub-sections are the same as for major sections. To keep things neat and easy to read, make sure you keep headings with their sections! Check just before you print out the final version of the document.

2.1.1 Sub-sub-sections (*Heading 3, Calibri, Italic, 14 point, 12 pt before, 6 pt after*)

Use two levels of indentations if really needed. An argument becomes near impossible to follow if further levels of indentation are used.

- (i) **Sub-sub-sub:** After that it gets difficult counting numerals, so best to use some other numbering system – which could be Roman lower-case numerals, as here, or (a), or just bullets. The text is now indented, with bold text used as required for clarity. (Sub-sub-sub, Cambria, 12pt, indented)

2.2 Tables, Figures etc.

Here is a typical table. It could be labelled Table 1. Please refer to tables and figures in the text before they appear in the document. You must give all tables and figures a proper descriptive title, as in the examples below.

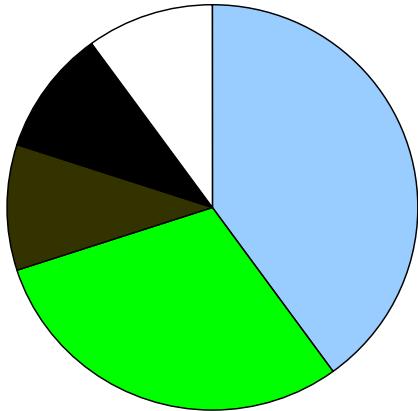
Tables should adhere to the visual styles given in Table 1. The font ‘style’ is ‘Table text’. The font for the title is ‘Figure’. Please make the table fit the page.

Reason	% of total
Slept in	48.5
Hung over	48.5

Moral objection	1.0
Mislaid bicycle/puncture	1.0
Really good reason	1.0

Table 1: Reasons for missing lectures for last year's MET2 class. Origin: A. Mole (2005).

Figure 1 shows another common type of figure. Usually, you will number figures and tables in order from the start of the report. In a long report, or one divided into several chapters, you may instead number figures within a chapter. For example, in chapter 2 the figures might be numbered 2.1, 2.2 etc.



- It's in the post
- My partner has it and he's ill
- What project report
- The dog ate it
- My partner ate it

Figure1: Reasons given for late hand-in of project reports. Origin: MET Office (2005).

2.2.1 Colour, Outsize Diagrams

Your report will need to be photocopied, and must be supplied in a form where it can be fed through the automatic feeder on a photocopier. Please, therefore **avoid** using colour or outsize figures if at all possible. If these are essential, then please supply six copies of the figure when you hand it your final report, and make sure the office knows where in the report they need to be inserted.

3.0 References

All the information you supply must be fully referenced, so that it is traceable. This includes oral comments from people in the company, as well as the more usual books, journals, websites. There are many ways of citing references, and all are acceptable. Important is that

you use the same style consistently throughout the report. The use of a reference management software is strongly advised (e.g. Mendeley, Zotero, Endnote) and can already be helpful to organize the evidence collection during the project.

First, where a reference arises in your text, it is essential that you cite the authors and publication date in the text. Some examples:

- Kimberley and Rogers (1999) claim that eggs are better than bacon.
- Eggs have been described by some authors as being better than bacon (e.g. Kimberley and Rogers 1999, Smith and Jones 2000).
- Eggs have been demonstrated experimentally as being better than bacon amongst middle income earners in Coventry (Blacksmith 2012).
- Quote a superscript number¹ or number in brackets [1].

Wherever you use a reference, you must provide the full reference in a list of references at the end of the document.

While referencing usually refers to citing books, reports and articles available in the public domain you will most likely use and thus need to cite internal company documents, but also interviews.

At the end of the report, you should have a section headed “REFERENCES” and all of the references used in the document should be listed in detail in alphabetical order. A sub-section may include a numbered list of people you have interviewed, so that these numbers can be referenced in the text.

Examples of referencing styles for books, journal papers, conference papers, websites and reports are provided below:

Journal or conference papers

Will Smith & Ken Rogers, “Automotive Engineer”, February 1999, pp 44-56; [Font style ‘Reference’, Cambria 12 pt, 3pt before 6 pt after, 1.2 line spacing, 0.5 hanging indent]

Borja de Mozota, B. (2002). "Design and competitive edge: a model for management excellence in European SMEs." Design Management Journal 2(1): pp. 88 - 104.

Books

Bruce, M. and J. Bessant (2002). Design in Business: Strategic Innovation Through Design. New York, Financial Times/Prentice Hall.

Reports/Websites

BSI (1995). BS 7000-10:1995 Design Management Systems - Part 2. London, British Standards Institute.

CIS, (2007), The CIS questionnaire and other details can be found online at
http://www.dius.gov.uk/science/science_and_innovation_analysis/cis.

Haskel J, Clayton T, Goodridge P, et al, (2009), Innovation, knowledge spending and productivity growth in the UK: interim report for NESTA 'Innovation Index' project, Innovation, knowledge spending and productivity growth in the UK: interim report for NESTA 'Innovation Index' project, 2010/02, Imperial College Business School

4.0 Report submission

At hand in, you must submit:

- An electronic pdf version, with a suitably chosen file name. A suggested file name convention is described below. This should be submitted by email to IfM Teaching Office (met-admin@eng.cam.ac.uk).

Naming a DRAFT report:

- Smith 2WP Draft 24-9-13.doc
- Replace 'Smith' with your surname(s)
- Replace '2WP' with either IP (Induction Project), 2WP (2 Week project), 4WP (4 week project), LP (Long project)
- Replace date with the submission date

A copy of your DRAFT goes to your supervisor for comment, and you will have a supervision within a few days of submission. There are normally some corrections to be made. After changes/corrections have been completed, hand in a final electronic copy to the IfM Teaching Office (met-admin@eng.cam.ac.uk).

Naming a FINAL report:

- Smith 2WP FINAL 25-9-13.doc
- Replace as above.

Your report should be produced using A4 pages only so that it can be fed through the automatic sheet-feeder on a photocopier. If anything cannot be treated in this way (outsize figures etc) you must seek advice and approval first.

The FINAL, corrected report is immediately sent off to the company for comment, and once this has been received copies of the report are bound and distributed.

5.0 Conclusion

If you have followed the advice in this document, you should be able to produce a report in an acceptable format! Suggestions for improvements are welcome.