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.

Contents

Introduction

MET IIB Teaching Staff

Dr Claire Barlow

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

Dr Michaël De Volder

IIB Modules: Production Technologies and Materials

Prof Steve Evans

IIB Modules: Sustainable Manufacturing

Dr Charles Featherston

IIB Modules: Enterprise, Globalization and Policy

Terry Hanby

IIB Modules: Strategy and Marketing

Dr Mark Khater

IIB Modules: Strategy and Marketing

Dr Mukesh Kumar

IIB Modules: Industrial Operations Management

Prof Tim Minshall

MET IIB Chair of Examiners

IIB Modules: Induction; Enterprise, Globalisation and Policy; Strategy & Marketing; Technology and Innovation Management

RAEng Visiting Prof Rick Mitchell

IIB Modules: Production Technologies and Materials; Technology and Innovation Management

Dr Dai Morgan

IIB Modules: Sustainable Manufacturing

Dr Letizia Mortara

IIB Modules: Technology and Innovation Management

Prof Duncan McFarlane

IIB Modules: Manufacturing Systems Engineering; Industrial Operations Management

Prof Bill O'Neill

IIB Modules: Production Technologies and Materials

Dr Eoin O'Sullivan

IIB Modules: Enterprise, Globalisation and Policy; Strategy and Marketing

Dr Ajith Kumar Parlikad

MET IIB Course Director

IIB Modules: Industrial Operations Management

Dr Rob Phaal

IIB Modules: Technology and Innovation Management

Tom Ridgman

IIB Modules: Induction

Dr Raj Srinivasan

IIB Modules: Manufacturing Systems and Engineering, Automation Lab

Dr Frank Tietze

Industrial Projects Coordinator

IIB Modules: Induction; Technology and Innovation Management.

Alan Thorne

IIB Modules: Manufacturing Systems and Engineering, Automation Lab

Dr Chander Velu

MET IIA Course Director

IIB Modules: Strategy and Marketing

Dr Doroteya Vladimirova

IIB Modules: Sustainable Manufacturing

IfM Teaching Office Staff

Shane Strawson
Senior MET Administrator

Sally King
Senior ISMM Administrator

Megan Flood
Administrator

Cassandra Richards
Administrator

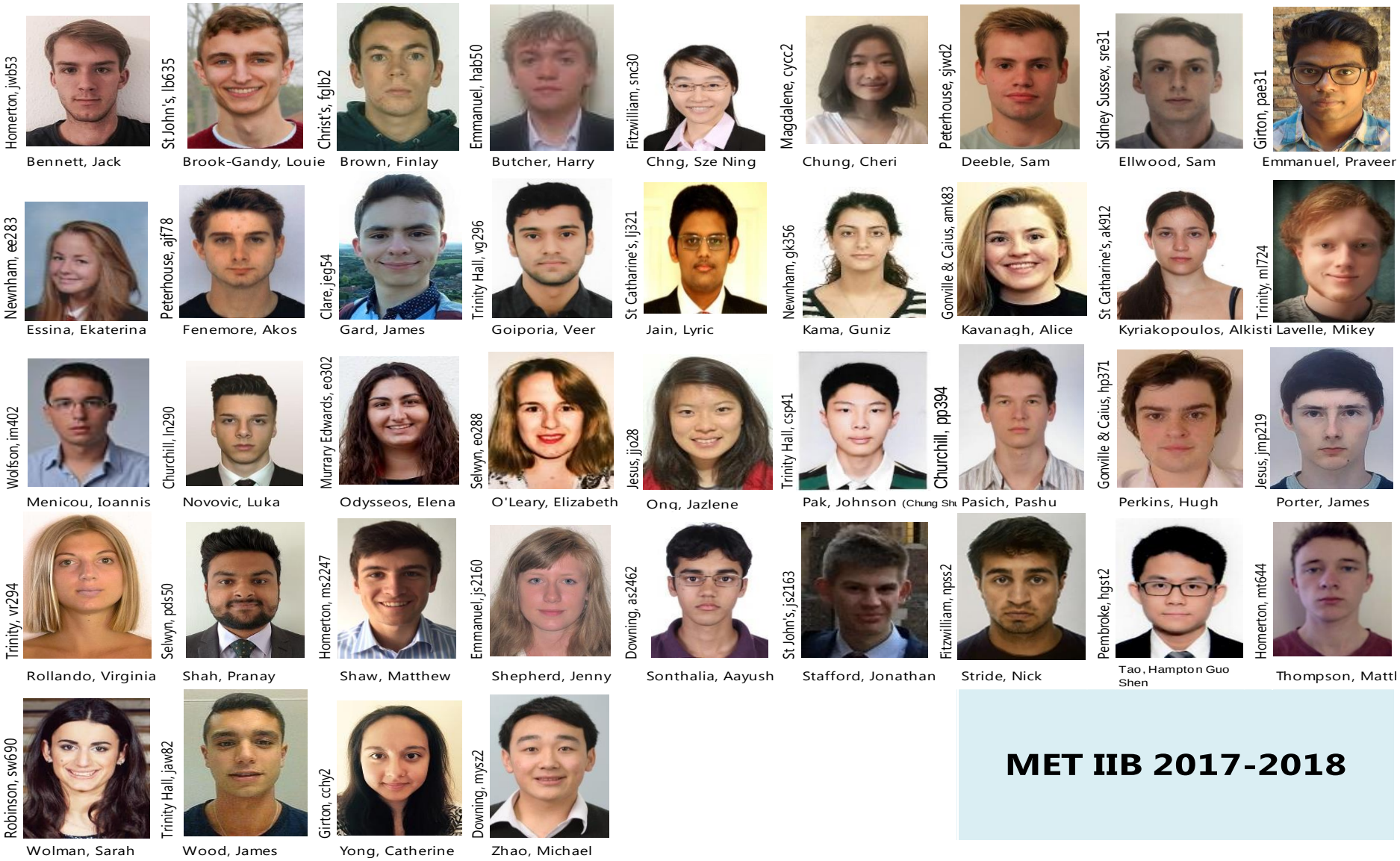
IfM Teaching Support Staff

Lewis Grantham
Computer Officer

Giles Hainsworth
Senior Computing Technician

Chris Jennings
Workshop Technician

Simon Sennitt
Workshop Technician


Homerton, jwb53
Bennett, Jack
St John's, lb635
Brook-Gandy, Louie
Christ's, fglb2
Brown, Finlay
Emmanuel, hab50
Butcher, Harry
Fitzwilliam, snc30
Chng, Sze Ning
Magdalene, cycc2
Chung, Cheri
Peterhouse, sjwd2
Deeble, Sam
Sidney Sussex, sre31
Ellwood, Sam
Girton, pae31
Emmanuel, Praveer
Newnham, ee283
Essina, Ekaterina
Peterhouse, ajf78
Fenemore, Akos
Clare, jeg54
Gard, James
Trinity Hall, vg296
Goiporia, Veer
St Catharine's, ij321
Jain, Lyric
Newnham, gk356
Kama, Guniz
Gonville & Caius, amk83
Kavanagh, Alice
St Catharine's, ak912
Kyriakopoulos, Alkisti
Trinity, ml724
Lavelle, Mikey
Wolfson, im402
Menicou, Ioannis
Churchill, ln290
Novovic, Luka
Murrary Edwards, eo302
Odysseos, Elena
Selwyn, eo288
O'Leary, Elizabeth
Jesus, jjo28
Ong, Jazlene
Trinity Hall, csp41
Pak, Johnson (Chung Shu
Churchill, pp394
Pasich, Pashu
Gonville & Caius, hp371
Perkins, Hugh
Jesus, jmp219
Porter, James
Trinity, vr294
Rollando, Virginia
Selwyn, pds50
Shah, Pranay
Homerton, ms2247
Shaw, Matthew
Emmanuel, js2160
Shepherd, Jenny
Downing, as2462
Sonthalia, Aayush
St John's, js2163
Stafford, Jonathan
Fitzwilliam, npss2
Stride, Nick
Pembroke, hgst2
Tao, Hampton Guo Shen
Homerton, mt644
Thompson, Mattl
Robinson, sw690
Wolman, Sarah
Trinity Hall, jaw82
Wood, James
Girton, cchy2
Yong, Catherine
Downing, mys22
Zhao, Michael
MET IIB 2017-2018

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 2017-2018

Week no/day	Week starting	Content
		Full term starts Tuesday 3rd October 2017
0 Mon	2nd October 2017	Induction/Enterprise, Globalisation and Policy Module
0 Tue	3rd October 2017	Induction Project Preparation
1 Wed	4th October 2017	Induction Projects
1 Mon	9th October 2017	Strategy and Marketing
2 Mon	16th October 2017	Technology and Innovation Management
3 Mon	23rd October 2017	2 week project
4 Mon	30th October 2017	2 week project
5 Mon	6th November 2017	Manufacturing Systems Engineering (MSE) / Robot Lab
6 Mon	13th November 2017	Robot Lab
7 Mon	20th November 2017	Industrial Operations Management
8 Mon	27th November 2017	Industrial Operations Management
		Full term ends Friday 1st December 2017
9 Mon	4th December 2017	Robot Lab
		Full term starts Tuesday 16th January 2018
0 Mon	15th January 2018	Production Technologies and Materials
1 Mon	22nd January 2018	Production Technologies and Materials
2 Mon	29th January 2018	4 week project 1
3 Mon	5th February 2018	4 week project 1
4 Mon	12th February 2018	Sustainable Manufacturing
5 Mon	19th February 2018	Overseas Research Project Preparation
6 Mon	26th February 2018	4 week project 2
7 Mon	5th March 2018	4 week project 2
8 Mon	12th March 2018	Long Project preparation
		Full term ends Friday 16th March 2018
		Full term starts Tuesday 24th April 2018
0 Tue	24th – 25th April 2018	Examinations
1 Mon	30th April - 8th June 2018	Long Project – 6 weeks
7 Mon	11th June 2018	Cambridge based
		Full term ends Friday 15th June 2018
	18th June 2018	May Week
	25th June 2018	Overseas Research Project preparation
	2nd July 2018	Overseas Research Project

Project Report Hand-In Dates 2017-2018

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 4th October to 6th October	08:45 Tuesday, 10th October	Friday 13th October	08:45 Wednesday 18th October
Michaelmas Project **2 weeks:** 23rd October to 3th November	08:45 Monday 6th November	Friday 10th November	08:45 Wednesday 15th November
Lent Project **4 weeks:** 29th January to 9th February 26th February to 9th March	08:45 Monday 12th March	Friday 16th March	08:45 Monday 19th March
Long Project: 12th to 16th March 30th April to 8th June	08:45 Monday 11th June	Monday 18th June	08:45 Wednesday 20th June

NOTE: 08:45 hand-in time ensures that you will not be late for lectures that start at 09:00

Staff Student Joint Committee meetings 2017-2018

Term	Date	Time
Michaelmas	23rd November 2017	13:00 – 14:00
Lent	22nd February 2018	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	28 marks
Technology and Innovation Management	14 marks
Strategy and Marketing	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: Dr Ajith Parlikad

Other IfM staff: Dr Frank Tietze, Tom Ridgman, Dr Charles Featherston

Dates: Monday 2nd October 2017 - 6th October 2017

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 2nd Oct	Tuesday 3rd Oct	Wednesday 4th Oct	Thursday 5th Oct	Friday 6th Oct
0900- 1030	Introduction, How to succeed on MET IIB, METIIB Structure, timetable and key dates. *Ajith Parlikad, Teaching Office team*	09:00 – 10:00 Introduction to mapping techniques *Tom Ridgman* 10:00-10:30 Introduction to Induction Projects and Supervisors	Induction projects at companies		
	Coffee				
1100-1230	Essential MET IIB skills *Frank Tietze*	Meetings with supervisors / travel to projects 12.30 METIIB Photograph	Induction projects at companies		
	Lunch				
1330- 1500	Complex and changing industrial landscape *Charles Featherston*	Meetings with supervisors / travel to projects	Induction projects at companies		
	Tea				
1530-1630	How do firms and governments respond to the changing landscape? *Charles Featherston*	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.
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.
Introduction to mapping techniques	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.

Introduction to Induction Projects	To have a clear understanding of the project brief, roles, and process for starting, managing and completing the project.
Induction Projects	To be aware of the key functions in a typical manufacturing company, and the connections between them. To experience the MET IIB style industrial project work. To have applied skills of evidence gathering, analysis, interpretation, collation and presentation. 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.

Reading list:

Module resources given on Moodle.

MET-IIB-2: Strategy and Marketing

Module leader:	Prof Tim Minshall and Dr Mark Khater
Other IfM staff:	Dr Chander Velu, Dr Mohammed Zaki
Dates:	Monday 9th October 2017 – Friday 13th October 2017
Location:	Alan Reece Building, LR2
Assessment:	End of module case study essay questions

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 9 – 13 October 2017 *This is a draft, a final version will be issued approx. 2 weeks before the start of the module.*

Time	Monday 9 Oct	Tuesday 10 Oct	Wednesday 11 Oct	Thursday 12 Oct	Friday 13 Oct
0900-1030	Module introduction *Tim Minshall* *Mark Khater* The Nature and Role of Marketing Marketing Objectives and Strategy *Chander Velu*	Manufacturing Strategy Theory and Cases *Mark Khater*	Manufacturing Strategy casework: final preparation and presentation *Mark Khater*	Performance Measurement Theory and Cases *Mohamed Zaki*	Assessment case study preparation
	Coffee break				
1100 -1230	Marketing Strategy Case study *Chander Velu*	Brands & Branding in the 21st Century *Terry Hanby*	Social Media Marketing and Strategy *Guy Peters* *Ogilvy and Mather*	Performance Measurement Theory and Cases *Mohamed Zaki*	Assessment case study preparation
	Lunch				
1330 -1500	Product Management *Chris O'Connor* *Techcomp Europe*	The Development of Brand Strategy *Terry Hanby* *Simon Patterson*	Free	Module review and key learning outcomes *Tim Minshall* *Mark Khater*	Module assessment – case study essay questions
	Tea				
1530 -1700	Assessment case study briefing 2-week project briefing *Tim Minshall*	Brands case study *Terry Hanby* *Simon Patterson*	Free	Assessment case study preparation	Free

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.	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

Changing views about brands – development of brand identity concepts, the brand identity prism, brand identity management	appropriate advertising and marketing campaign.
Manufacturing Strategy Strategy frameworks The importance of strategy alignment Competitive criteria Structural and infrastructural factors	Discuss and apply the stages in the development of a business linked manufacturing strategy
Performance Measurement Why companies need to measure performance Performance Measurement frameworks How to link measures to strategy How to develop appropriate performance measures How to manage using performance measures	Describe the role of performance measurement in the successful management of a business. Demonstrate the application of key concepts to a business case.
Social Media Marketing and Strategy The application of social media methods as part of the marketing strategy of an organisation The role that such methods can play in the marketing mix Relevance in different company contexts	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

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

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

Dates: Monday 16 October – Friday 20 October 2017

Location: Alan Reece Building, Lecture Room 2

Assessment: End of module written test

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

Demonstrate knowledge and understanding of:

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

Demonstrate the ability to:

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

Technology and Innovation Management **16 - 20 October 2017** *This is a draft timetable and may be subject to changes*

	Monday 16 Oct	Tuesday 17 Oct	Wednesday 18 Oct	Thursday 19 Oct	Friday 20 Oct
0900-1045	**0900-0945** Introduction to Long Projects *Frank Tietze* **0945-1045** Module introduction Philips case, models *Frank Tietze*	Strategic technology management *Rob Phaal*	Make versus Buy *Tim Minshall*	CityCar simulation *Thomas Bohne*	Commercialising F1 technology *Christian Bedford*
Coffee					
1100-1230	Evolution of industries, technologies and markets *Tim Minshall*	Technology Roadmapping *Rob Phaal*	Intellectual property management *Frank Tietze*	CityCar simulation (continued) *Thomas Bohne* *(Runs to 13:00)*	Module review and key learning outcomes *Frank Tietze*
Lunch					
1330-1500	ISAEP model *Tim Minshall*	Open innovation *Tim Minshall*	Free	CityCar Debrief *Thomas Bohne / Rick Mitchell* *(Start at 14:00)*	Module assessment
Tea					
1515-1700	NPI and innovation *Rick Mitchell*	Technology intelligence *Letizia Mortara*	Free	CityCar Debrief continue *Thomas Bohne / Rick Mitchell*	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
Make versus Buy (MvB) **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 Management	Appreciate the critical importance of effective intellectual property in innovation processes To be aware of the complexity of IP issues in the development and commercialisation of emerging technologies
CityCar simulation	Experience the challenges in innovation projects and apply learning of module lectures
Module review	Be able to summarise the key leanings from the module
Module assessment	Demonstrate understanding of key module themes

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.

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

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, Dr. Raj Srinivasan, Simon Sennitt, Chris Jennings
Dates:	Taught Component: Monday 6th – Thursday 9th November 2017 Practical Component: 10th November; 13th – 17th November 2016; 4th – 8th December 2017
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%).

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 6 – 10 November 2017 *This is a draft timetable and may be subject to changes*

		Morning			**Afternoon**	
Monday 6 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 Innomech Ltd. Alan Thorne / Duncan McFarlane Simon Sennitt	**14.00-17-00**	Robot Lab Robot Lab Planning, definition of groups, selection of managers, specification of performance measures, initial work schedules including Lab tutorials, risk assessments	Student Led Alan Thorne
Tuesday 7 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	Barry Graham Justin Baker Omron	**14-00 -** **16-00**	Tutored practical exercises (cont'd) Lab Equipment tutorials	Justin Baker Omron Alan Thorne et al
Wednesday 8 Nov	**09-00** **10-00 -** **12-00**	Sensors in Automation Fixturing and End effectors Cell control and system testing Cell Managers to meet with AT/DCM after end of session	Alan Thorne Alan Thorne / Duncan McFarlane		**Free**	
Thursday 9 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**	Introduction to Robotics Applications, Methods of Programming, Integration Lab Equipment tutorials	Alan Thorne Alan Thorne et al
Friday 10 Nov	**09-00 – 13-00**	ROBOT LAB Lab Equipment tutorials	Alan Thorne, Duncan McFarlane et al	**14-00 - 17-00**	ROBOT LAB	Alan Thorne, Duncan McFarlane et al

MSE/Robot Lab – Week 2 13 – 17 November 2016 *This is a draft timetable and may be subject to changes*

		Morning		Afternoon
Monday 13 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 14 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 15 Nov	**09-00 - 13-00**	**ROBOT LAB** Alan Thorne, Duncan McFarlane, Chris Jennings, Simon Sennitt		**Free**
Thursday 16 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 17 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 4 – 8 December 2017 *This is a draft timetable and may be subject to changes*

		Morning		Afternoon	
Monday 4 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 5 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 6 Dec	**09-00 - 13-00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt		**Free**	
Thursday 7 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 8 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	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt

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

Manufacturing Systems Engineering - Syllabus and session learning outcomes

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 robot 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

Sensors in automation Requirements for sensing in automated systems Types of sensor Connecting sensors into systems Benefits and limitations of different sensor types Sensor applications	Know the different types of sensor used in automation Choose an appropriate sensor, and understand the importance of the correct application of sensors in designing robust systems. Implement sensor technology into automated systems
Fixturing and end effectors Principles of fixture design Factors affecting accuracy and repeatability Kinematic location Methods of clamping Sensor requirements for fixtures in unmanned operation	Understand the basic principles of tool and fixture design for automated operations. Design and build simple fixtures and robot end effectors.
Cell control Different approaches to cell control Centralised and decentralised control systems Auto-ID technologies Monitoring and visualisation, SCADA systems	Understand the basic principles of machine and cell control. Specify a control architecture for a simple automated manufacturing cell Understand the need for, and how to deal with, mixed product production in automated cells
Programmable logic controllers PLC vs. PC for cell control Functionality of modern PLCs Methods of PLC programming: ladder logic; sequential function charts Communications and networks, deterministic versus non deterministic; Industrial networks, Devicenet, Ethernet, Profibus etc.	Know the state of the art in PLC control, and factory communications technology. Be able to develop and test simple PLC programmes Understand the methods of linking PLCs into factory systems

MET-IIB-5: Industrial Operations Management

Module Leader:	Dr Ajith Parlikad
Other IfM staff:	Dr Alexandra Brintrup, Dr Mukesh Kumar, Prof Duncan McFarlane, Dr Mohamed zaki, Dr Zhenglin Liang, Pascal Wichmann
External Speakers:	Tim Close (McKinsey); Chris Weeks (Caterpillar); Others TBC
Dates:	Monday 20 November 2017 – Friday 1 December 2017
Location:	Alan Reece Building, Lecture Room 2
Assessment:	Coursework assignment

Module Learning Outcomes

By the end of the module students will be able to:

- Understand the complex nature of business decision-making and develop a suitable approach to model decisions.
- Understand the concept of risk and resilience in the context of industrial systems and apply them to decision making.
- Understand and apply data analytics techniques for analysing industrial data to reveal insights for the business.
- Understand and apply machine learning and artificial intelligence techniques to solve industrial problems.
- Understand how advanced data analytics and decision-making is transforming industries.

Industrial Operations Management week 1 - 20 November – 24 November 2017 *This is a draft timetable and may be subject to changes*

Time	Monday 20th Nov	Tuesday 21st Nov	Wednesday 22nd Nov	Thursday 23rd Nov	Friday 24th Nov
Theme	**Decision Theory**	**Operations Research**	**Risk and Resilience**	**Data Modelling**	**Data Modelling**
0900-1030	0900-0930 Module overview and assessment *Dr Ajith Parlikad* 0930-1030 Introduction to decision making *Dr Ajith Parlikad*	0900-0930 Introduction to Operations Research *Dr Ajith Parlikad* 0930-1030 Linear Programming [Formulation, Graphical method] *Dr Alexandra Brintrup*	Introduction to risk and resilience *Dr Mukesh Kumar*	Introduction to Data Science *Dr Alexandra Brintrup*	Business Analytics: Regression techniques *Dr Alexandra Brintrup*
Coffee					
1100-1230	Decision-making under uncertainty and risk *Dr Ajith Parlikad*	Linear Programming [Simplex method, Duality, Applications] *Dr Alexandra Brintrup*	Risk analysis in Supply Chains *Dr Mukesh Kumar*	Business Analytics: Sampling *Dr Alexandra Brintrup*	Hands on Session: Regression *Dr Alexandra Brintrup*
Lunch					
1330-1630	1330-1500 Game theory *Dr Ajith Parlikad* 1500 onwards FREE	Hands on session: Linear Programming in Excel *Dr Alexandra Brintrup*	Coursework	Hands on Session: Sampling *Dr Alexandra Brintrup*	Coursework

Industrial Operations Management week 2 - 27 November – 1 December 2017 *This is a draft timetable and may be subject to changes*

Time	Monday 27 Nov	Tuesday 28 Nov	Wednesday 29 Nov	Thursday 30 Nov	Friday 1 Dec
Theme	Machine Learning	Machine Learning	Digital Services	Digital Manufacturing	Assessment
0900-1030	Introduction to Machine Learning *Pascal Wichmann, Zhenglin Liang*	Deep learning and Neural networks *Pascal Wichmann, Zhenglin Liang*	Servitisation of Manufacturing *Dr Mohamed Zaki*	Digital Manufacturing / Industrial Internet of Things *Prof Duncan McFarlane*	Coursework
Coffee					
1100-1230	Machine Learning Techniques *Pascal Wichmann, Zhenglin Liang*	Applications and Case Studies *Pascal Wichmann, Zhenglin Liang*	Servitisation in Industry *Caterpillar*	Industry 4.0 *Tim Close (McKinsey)*	Coursework
Lunch					
1330-1630	Machine learning coding session *Pascal Wichmann*	Machine learning coding session *Pascal Wichmann*	FREE	13-30-1500 Industry talk (TBA) 1500 – onwards *Coursework*	Submit all assignments by 1600

Industrial Operations Management - Session syllabus and learning outcomes

Session	Session learning outcomes
Decision Making	
Decision-making under uncertainty	Understand how uncertainty and risk influence decision-making Learn different approaches for making decisions under uncertainty
Decision-making under risk	Learn different approaches for making decisions under risk (e.g. decision trees) Understand the value of information in decision-making
Game Theory	Understand the basics of Game Theory and how it can be used to understand business decisions
Introduction to Operations Research	Identify the role of optimization in a range of business decisions Understand different types of decision models and optimization techniques used to address them
Linear Programming (incl. practical session)	Learn to formulate a LP problem Learn how to solve a linear programming problem Learn how to structure and solve an LP using Excel
Introduction to risk and resilience	Understand the key terminology: Uncertainty, vulnerability, risk and resilience Learn different approaches for risk assessment Learn how to manage risk and develop resilience
Risk and resilience in supply chains	Learn how to identify key risks in industrial supply chains Understand the interdependencies between different types of supply chain risks Learn different approaches for quantify and analyse risk in supply chains

Data Analytics	
Introduction to data science	Understand the range of logical and structured applications of modern analytics and their role in supporting decision making in business
Business analytics **(Including case studies)**	Learn how to interpret and use analytics to structure decision problems Apply business analytics through a range of industrial case examples Recognise different types of analytics technology and identify their applications in industry
Introduction to Machine Learning	Understand the fundamental theory of machine learning and artificial intelligence Understand where machine learning can be usefully applied
Machine Learning techniques **(incl. practical sessions)**	Learn different machine learning techniques, their pros and cons, and where to apply them
Deep Learning and Neural Networks	Learn the underpinning concepts behind latest developments in Machine Learning
Machine Learning applications and case studies	Learn various applications of machine learning techniques to manufacturing problems
Servitisation of Manufacturing **(Incl. industrial example)**	Discuss the key differences between manufacturing and services. Discuss the concepts of servitisation and the key challenges in offering services.
Industry 4.0 **(incl. industry speaker)**	Learn about Industry 4.0 – what is driving it, and how it might impact Manufacturing Understand the challenges for companies and learn how organisations can take full benefit from it Understand what the future looks like for "Digital Manufacturing"
Industrial speakers	Learn the challenges faced by industry in different sectors and how data analytics, machine learning and optimization techniques are used to address these challenges.

Reading List

Core texts

1. Hillier, F.S., Introduction *to Operations Research,* McGraw Hill. Provides a good coverage of decision theory and optimization methods covered in the course.
2. Wisniewski, M. *Quantitative methods for decision makers*, Prentice Hall. Provides coverage at a suitable level of most of the topics on the course. Features practical examples and some extracts from the Financial Times.
3. Manmohan S., and Christopher S. Tang. *Managing supply chain risk*. Vol. 172. Springer Science & Business Media, 2012.
4. Murphy, K., *Machine Learning – A Probabilistic Perspective*, MIT Press

Additional reading

1. Allingham M., *Choice Theory*, Oxford University Press.
2. Ostrom, Lee T., and Cheryl A. Wilhelmsen. *Risk assessment: tools, techniques, and their applications*. John Wiley & Sons, 2012.
3. Khan, Omera, and George A. Zsidisin. *Handbook for Supply Chain Risk Management: Case Studies, Effective Practices, and Emerging Trends*. J. Ross publishing, 2012.
4. Sheffi, Yossi. *The resilient enterprise: overcoming vulnerability for competitive advantage*. MIT Press Books 1 (2005).
5. Bernstein, Peter L., and L. Bernstein Peter. *Against the gods: The remarkable story of risk*. New York: Wiley, 1996.

MET-IIB-6: Production Technologies and Materials

Module Leader: Dr. Ronan Daly

Other IfM staff: Prof Bill O'Neill

Dates: Monday, 15th January 2018 – Friday, 26th January 2018

Location: Alan Reece Building, Lecture Room 2

Assessment: Assignment group presentation [25%], End of module test [75%]

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 **15 January – 19 January 2018** *This is a draft timetable and may be subject to changes*

Time	Monday 15th Jan	Tuesday 16th Jan	Wednesday 17th Jan	Thursday 18th Jan	Friday 19th Jan
0900 -1030	0900 – 1000 Presentations of 4 week project choices *Frank Tietze* 1000 – 1030 Module Introduction *Bill O'Neill & Ronan Daly*	Production technologies and Automation *Alan Thorne*	The challenges of food manufacturing Mars	Advanced Processes: Additive manufacturing *Bill O'Neill*	Advanced Processes: Micro and nano manufacturing *Ronan Daly*
	Coffee break				
1045 -1215	PTM Project Assignment	Manufacturing food and food manufacturing *Ian Wilson*	Ultra-precision production technologies *Bill O'Neill*	Additive manufacturing Renishaw	Challenges of micro and nano manufacturing Pilkington
	Lunch				
1330 -1500	Visit to assigned company for PTM project introduction	PTM Assignment: Group work	Advanced Processes: Laser processing *Bill O'Neill*	PTM Assignment: Group work	Challenges of micro and nano manufacturing Intel
	Tea				
1515 -1645	Team de-brief at IfM	PTM Assignment: Group work	Free	PTM Assignment: Group work	PTM Assignment: Group work

PTM – Week 2 **22 January – 26 January 2018** *This is a draft timetable and may be subject to changes*

Time	Monday 22nd Jan	Tuesday 23rd Jan	Wednesday 24th Jan	Thursday 25th Jan	Friday 26th Jan
0900 - 1030	Carbon and its applications *Michael De Volder*	Advanced polymers *Niamh Willis - Fox*	Production Process Technologies *Ronan Daly*	Preparation for group presentations	Module Assessment Preparation
	Coffee				
1045 -1215	Carbon fibre composites: Material and applications *Marco Archideacon* *Hexcel*	New opportunities in biopolymers *Claire Barlow*	Joining : Adhesive Bonding *Stuart Thompson* *Huntsman*	PTM Assignment Group Presentations	Module Assessment
	Lunch				
1330 - 1500	Carbon fibre composites: F1 applications *Steve Foster* *McLaren*	Challenges of manufacturing with polymers *TTP*	Continuous manufacturing and advanced technologies *GSK*	PTM Assignment Group Presentations	Module Wrap-up
	Tea				
1515 -1645	PTM Assignment Group work	PTM Assignment Group work	Free	Module Assessment Preparation	Free

Production Technologies and Materials – Syllabus and session learning outcomes

Syllabus	Session learning outcomes
Production Technologies and Automation The relationship between product characteristics and assembly method: volume/complexity. Overview of different assembly system configurations. The advantage / disadvantage of hard/soft automated systems. The role and application of reprogrammable robotic assembly methods Case studies	Make informed choices of assembly system (including automation) components Appreciate the range of additional supporting processes and activities that are needed to implement such a system. Justify a choice of assembly automation system taking into account product lifecycle and flexibility requirements.
Manufacturing food and food manufacturing Food manufacturing as a multi-scale assembly process The shape of the food manufacturing sector and the food marketing environment Legal and economic factors in the food sector Multi-product manufacturing Microbiology and food safety HACCP The need to clean	Appreciate the complexity of processes used to manufacture different foods Identification of the multi-disciplinarily of food manufacturing Appreciation of the factors affecting food spoilage and food safety, including HACCP
Ultra-precision production technologies Definition of ultra-precision manufacturing Manufacturing processes at the very small scale, their characteristics and limitations	Understand the range of micro-manufacturing and ultra-precision techniques for processing components from metals, ceramic and polymers. Understand their potential and limitations in manufacturing next generation products Be aware of the choice of manufacturing techniques for different applications.
Advanced processes: Laser processing Global context of industrial laser manufacturing markets Modern high power industrial lasers and their systems Laser manufacturing across the length scales Principal applications of industrial laser systems	Understand the scale, operation and impact of high power industrial laser systems in the global market place. Understand the means by which lasers can manipulate material for manufacturing applications Understand the basic laser based manufacturing techniques and technologies.

Future developments of laser technology	Appreciate where and how industrial lasers may replace traditional manufacturing technologies.
Advanced processes: Additive manufacturing Fundamental rapid prototyping concepts for the production of 3D objects Application in design and production Additive manufacturing concepts and the drive the mass customization Application studies	Understand the basics of additive manufacturing operations Understand the means by which these technologies can be applied in manufacturing applications. Appreciate the benefits and limitations of additive technologies.
Advanced processes: Micro and Nano manufacturing Describe a range of micro and nano manufacturing techniques for processing components from metals, ceramic and polymers and understand their potentials and limitations.	Build knowledge of a range of techniques / production technologies. Understand how to choose between techniques for different applications. Appreciate the role of metrology techniques in validating production.
Carbon and its applications Structure, properties, synthesis and processing of CNTs. Application and market development Safety	Understand the manufacturing processes, properties and a range of potential applications of CNTs.
Carbon Fibre Composites – materials Manufacturing processes and applications for carbon fibre and associated materials for composite structures Development of the composites business and future prospects for CFRP	Appreciate the technological, logistic and economic complexities of CFRP manufacture and use in composite structures Understand the constraints and opportunities for wider application of CFRP
Advanced Polymers Definitions, properties and applications of advanced polymers. Monitoring and validating polymer properties	Understand the changing role of polymers in industry. Understand the basics of sampling, measuring and validating polymer batches.

New opportunities in biopolymers Definitions, properties and applications of biopolymers. Environmental issues – examples of life-cycle assessments.	Understand the production, applications and properties of various common biopolymers and the environmental consequences of their use.
Production Process Technologies Definition and categorization of production process industry Introduction to Continuous and Batch processes Example unit operations Production process design	Appreciate the range of industries linked to production processes Understand the choice between continuous and batch manufacturing Develop basic design skills for production processes
Joining – adhesive bonding Chemistry of adhesives and the batch manufacturing routes for their production Background to the application of advanced adhesives Principal applications of industrial adhesives New developments of adhesive technology	Understand the basic operational and manufacturing principles of adhesives Understand the current range of adhesive formulations and areas of application Understand the importance of adhesives to the wider manufacturing industry.
Continuous manufacturing and advanced technologies in manufacturing Current manufacturing technology in the pharmaceutical industry The drivers for change in manufacturing Unit operations and continuous manufacturing technologies Emerging advanced manufacturing techniques	Understand the global challenges facing the pharmaceutical industry and why dramatic changes are needed Be able to describe the key goals in moving from batch to continuous manufacturing Be able to describe a selection of processing techniques for batch and continuous manufacturing Understand the links between the broader supply chain and manufacturing choices

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, value analysis/ value engineering and factors affecting choice of materials and processes are also addressed. The assignment allows the students to apply these ideas to real examples of assembly operations.

Assignment Activities and Process

Students are grouped into teams of four or five. Each team is allocated a product which is manufactured at a factory within an hour's travel from Cambridge. In addition to the finished assembly or sub-assembly, each team is provided with individual parts and/or components, drawings and parts lists where relevant, and contextual information regarding the product and manufacturing company – for example volume of production, market size, competitive position. Each team is set a task on their visit to the company. The tasks will vary according to the product in question and could include aspects such as a critical analysis of assembly methods, material selection, design optimisation, and process optimisation. The challenge is for the team to break down the task into its component production technology/materials challenges and also the financial/commercial considerations. The results of each project group are presented in a debrief to the class at the end of the module.

Debrief

Each team prepares a 20 minute presentation for the entire class at the end of the module, summarizing their initial findings and suggested next steps. Suggestions and recommendations are sent to the host factory, together with a letter of thanks. 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?

MET-IIB-7. Sustainable Manufacturing

Module leaders: Dr. Doroteya Vladimirova

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

Dates: Monday 12 February – Friday 16 February 2018

Location: Alan Reece Building, lecture room 2

Assessment: Written case study assessment

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 12 – 16 February 2018 *This is a draft timetable and may be subject to changes*

Time	Monday 12th Feb	Tuesday 13th Feb	Wednesday 14th Feb	Thursday 15th Feb	Friday 16th Feb
0900-1030	Module Introduction *Dr Doroteya Vladimirova* Industry & Sustainability *Prof Steve Evans*	Packaging and sustainability *Dr Claire Barlow*	Sustainable Business Innovation *Dr Doroteya Vladimirova*	Case study: Riversimple *Prof Steve Evans*	Module assessment preparation
Coffee					
1100-1230	Eco-Audit reprise: Carbon Footprint Assessment *Dr Hugh Shercliff*	Sustainable systems & case study: AB Sugar Wissington *Dr Dai Morgan*	Sustainable Business Innovation *(continued)* *Dr Doroteya Vladimirova*	Future of industrial sustainability *Prof Steve Evans*	Module assessment preparation
Lunch					
1330-1500	Energy & Lifecycle Analysis *Dr Stuart Scott*	Case study: Vitsœ Eco Factory *Mark Adams*	Free	Module assessment preparation	14:30 Deadline for hand-in of module assessment report to Teaching office.
Tea					
1530-1700	Eco Audit Coursework	Module assessment preparation	Free	Module assessment preparation	Free

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., CULLEN, J.	*Sustainable materials – with both eyes open* 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

The Induction Project

The Induction Project serves as an introduction to the industrial projects component of MET IIB. 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 information and material in a manufacturing company.

Setting up the projects

The projects run in five 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 **08:45 on the Tuesday 10th 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 **08:45 on Wednesday 18th 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 2017

- Projects: 4th October to 6th October.
- Company presentation: Afternoon (possibly late morning) 6th October.
- Reports handed in to MET Office: **before** 08:45 Tuesday, 10th October. NOTE: both paper and electronic copies are required.
- Supervision with academic supervisor: by end of Friday 13th October.
- Revised reports (including revisions requested by supervisor) handed in to MET office by 08:45 Wednesday 18th October.
- Reports sent to companies by Friday 20th 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 handed in to the MET Office by the due date. Both hard copy and electronic copies are required. 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 Office staff will forward the hard copy and hand-over file 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 Office sends 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 2017-2018".

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, <u>not</u> the corrected version. Please ensure that you return draft copies with supervisor comments to the office after you have made your corrections. These need to be kept by the MET Office for the Examiners to review.

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 office BEFORE the due date, or in extreme circumstances with the written agreement of the 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

MET staff make available suitable projects for students to choose from on a Moodle page but students are encouraged to find and develop their own projects. Students will be introduced to the project selection process.

Students wishing to propose their own projects 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 wishing to propose their own projects must make this clear on their Long Project Preference Questionnaire, and have their proposal agreed with the MET IIB Director (Ajith Parlikad) and Projects Coordinator (Frank Tietze) by the 22nd January 2018.

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'.

Detailed arrangements for hand-in of long projects will be explained during the preparation phase.

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

2nd October 2017	MET IIB starts.
16th October 2017	Students introduced to the Long Project Timetable. Students briefed on scope and requirements for projects. Students begin search for potential project topics. Questionnaires completed leading to assist with preliminary allocation of supervisors.
6th November 2017	Questionnaires returned to IfM Teaching Office. Preliminary allocation of supervisors.
4th December 2017	All students should have met with their supervisor to initiate discussion.
15th January 2018	Lent term starts.
TBC / January 2018	Long Project briefing, topics covered will include: review of timetable, review of supervisor list.
19th January 2018	Preliminary list of student projects is drawn up.
22nd January 2018	Cut-off for student self-selection of projects.
5th February 2018	Supervisors fill gaps in student project allocation.
12th March 2018	Start of preparation week. By the end of the week students should agree a project brief and plan (Gantt chart) with university and company supervisors, and give it to the IfM Teaching Office.
30th April 2018	Projects restart
8th June 2018	Last day for project presentations.
11th June 2018	Reports submitted.

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 (Ajith Parlikad).

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. Lon 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 a 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.

- **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.

iii. **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. The MET Office has not 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 small 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 MET 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.

ii. Every effort is made to select comfortable and hygienic accommodation, but proprietors can change from year to year with unpredictable results. If the accommodation is totally unsatisfactory and the students are unable to sort out the problems amicably with the proprietors, they should phone the MET Office as soon as possible.

iii. To help with future planning students should use the student feedback form to comment on the accommodation.

iv. 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 <u>never</u> 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.

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 at the end of each project period, using the University Expense Forms from the MET Office. **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. Claims for expenses should therefore be submitted to the IfM Teaching Office at the same time as the final report and the student feedback form. 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 MET 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 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 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 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 Teaching Office.

ii. Emergency work necessary while the vehicle is away from Cambridge must be authorised by the 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 AA membership and Relay. 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. Expenses will not normally be paid for travel within Cambridge i.e. within a 3 mile radius of Great St Mary's Church.

iii. 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 extra curricular.

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 Office 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 MET 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	Appoint the student project leader and three team members responsible for sponsorship, research and logistics respectively. Agree the research location. Plan B is essential. Outline the research topic or options.
Over the summer break	Continue planning. Keep MET IIB Director. MET Office, and IfM-ECS Communications Officer informed of developments.
By start of Michaelmas term	Identify and contact potential sponsors. Develop a refined statement of the research topic. Draft the project brochure for sending to sponsors and companies, in discussion with IfM-ECS Communications Officer.
As early as possible	Confirm the outline of the programme. Identify target companies for visits. Negotiate timing of visits to companies. Confirm with the MET IIB Director who from IfM will be accompanying the tour.
Preparing the Project Report	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. 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.
Following the tour	Immediately on return from the tour **students should complete the project report**, which must be signed-off by the MET IIB Director before publication. IfM-ECS Communications Officer will be able to assist with the dissemination of the report. A presentation summarising the report should be arranged as part of the IfM Friday Seminar Series (coordinated by Dr Yongjiang Shi)

Appendix 1: Referencing and Plagiarism

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

Appendix 2: Sample MET IIB Forms

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:……

Assessed by: …… Date : .....

Mark each category out of 100 and then weight as indicated for overall mark.

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%	(unsatisfactory)

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 (%)

A. Success in Meeting Objectives ☐

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"?
Comments

B. Quality of Project Approach ☐

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?
Comments

C. Oral Presentation of Results ☐

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?
Comments

D. Structure and Style of Report ☐

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?
Comments

E. Report Content ☐

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?]
Comments

Overall Mark *(Weight factors as shown)* ☐
(0.3xA) + (0.2xB) + (0.15xC) + (0.15xD) + (0.2xE)

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:.....

Assessed by: ..... Date: .....

Mark each category out of 100 and then weight as indicated for overall mark.

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%	(unsatisfactory)

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%.

	Supervisor's Mark (%)	Assessor's Mark (%)	Agreed. Mark (%)
A. Success in Meeting Objectives *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"?* *Comments*	☐		
B. Quality of Project Approach *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?* *Comments*	☐		
C. Oral Presentation of Results *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?* *Comments*	☐		
D. Structure and Style of Report *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?* *Comments*	☐	☐	☐
E. Report Content *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?]* *Comments*	☐	☐	☐

	Supervisor's mark %	Agreed mark %
Overall Mark *(Weight factors as shown)* (0.3xA) + (0.2xB) + (0.15xC) + (0.15xD) + (0.2xE) (This sheet will be kept confidential – i.e., it is not copied to students or companies)	☐	☐

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:.....

Assessed by:.....Date:.....

Mark each category out of 100 and then weight as indicated for overall mark.

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%	(unsatisfactory)

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%.

	Supervisor's Mark (%)	Assessor's Mark (%)	Agreed. Mark (%)
A. Success in Meeting Objectives *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"?* *Comments*	☐		
B. Quality of Project Approach *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?* *Comments*	☐		
C. Oral Presentation of Results *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?* *Comments*	☐		
D. Structure and Style of Report *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?* *Comments*	☐	☐	☐
E. Report Content *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?]* *Comments*	☐	☐	☐

Overall Mark *(Weight factors as shown*
(0.25xA) + (0.3xB) + (0.1xC) + (0.1xD) + (0.25xE)
(This sheet will be kept confidential – i.e., it is not copied to students or companies.)

Supervisor's mark % ☐ **Agreed mark %** ☐

Supervision payment: 4 week project: Claim per student - 6 hours in a class of 2 (Note: not a class of 4 for this purpose; this allows for some individual student review, particularly mid-project)

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

The project report needs not only to supply the company with full and appropriate information about the project, but it should also act as a 'handover document'. This means that it should convey a complete picture of the project to someone who has not been involved in it, so that for example someone in the company should be able to use the material. Supervisors should assess the project report against the criteria below, and agree a mark with the project assessor. The assessor is asked to grade the project against content (so far as it can be judged), but the most important criterion is the 'handover' element in criterion E. Note that their assessment of this may be more valid than that of the supervisor. Assessors must be prepared to discuss marks with supervisors before 15 June. Supervisors should arrange to discuss mark discrepancies with assessors in time to submit the agreed mark and the project assessment forms to the IfM Teaching office by **4 pm** on **Friday 15 June 2018.** The Project Coordinator will arbitrate any unresolved disputes.

Student:..... Date: .....

Supervised by.....Assessed by: .....

Mark each category out of 100 and then weight as indicated for overall mark.

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%	(unsatisfactory)

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%.

	Supervisor's Mark (%)	Assessor's Mark (%)	Agreed. Mark (%)
A. Success in Meeting Objectives *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"?*	☐		
B. Quality of Approach *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?*	☐	☐	☐
C. Oral Presentation of Results *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?*	☐		
D. Structure and Style of Report *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?*	☐	☐	☐
E. Report Content *Did the report convey a full and accurate 'picture' of the project? Did it contain a thorough analysis and the relevant supporting data? Were the boundaries of the project and all relevant assumptions clearly identified? Were there sensible conclusions and clear recommendations?*	☐	☐	☐

Overall Mark *(Weight factors as shown)* (0.3xA) + (0.2xB) + (0.15xC) + (0.15xD) + (0.2xE)	**Supervisor's mark %**	**Agreed mark %**
	☐	☐

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 ☐ Bound report required ☐

Signed…… Date……
Company supervisor

University Supervisor's response

Industrial Project – Sample student feedback form

MANUFACTURING ENGINEERING TRIPOS

Students Report on Industrial Projects

PROJECT TITLE: COMPANY: CAMBRIDGE SUPERVISOR:	MODULE: Two-weeks Project DATES: 28th October – 8th November 2013 NAMES

1. What were the major benefits to you from this project?

2. What contributions were you able to make?

3. What level of support and guidance did you receive?

4. Should MET projects be carried out at this company again? If so, have you recommendations for subject area.

Comments on the accommodation:
(please give name and location of hotel/B&B)

IfM MANAGEMENT TECHNOLOGY POLICY

UNIVERSITY OF CAMBRIDGE

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 DAMANGE, LOSS OR DEFECTS OF ISSUED ITEMS TO LOCAL SUPERVISOR	
6	HOUSEKEEPING, TOILET FACILTIES, 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.

2

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

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

IfM **Manufacturing Engineering Tripos**

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

Contents

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 12 pt, 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.

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

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, 3 pt before, 6 pt 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.

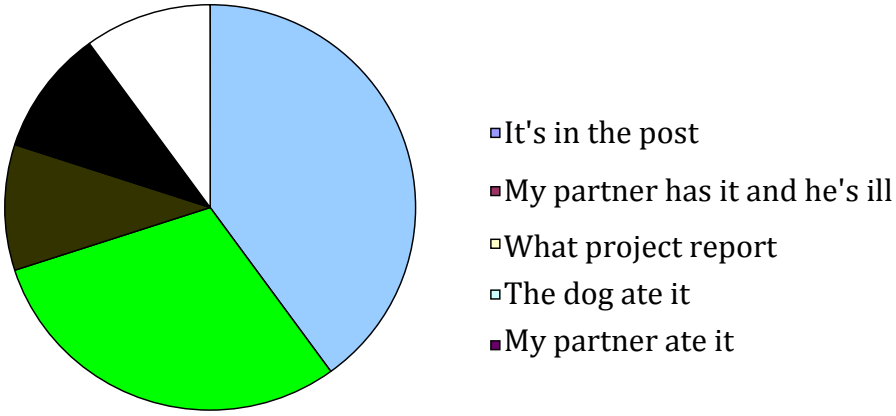


Figure1: Reasons given for late hand-in of project reports. Origin: MET Office (2005).

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 number[1] 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:

- One hard copy of your report to the MET office by the due date.
- An electronic version, with a suitably chosen file name. A suggested file name convention is described below. This should be submitted by email to Teaching Office.

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

The paper 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 paper copy to the MET office. Also email an electronic copy to 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.