UNIVERSITY OF CAMBRIDGE

Department of Engineering

Institute for Manufacturing

MET IIB Course

Handbook 2022-23

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

People involved in MET IIB

MET IIB Teaching Staff

Dr Claire Barlow

IIB Modules: Sustainable Manufacturing, Production Technologies and Materials

Prof Alexandra Brintrup

Industrial Project Supervisor

IIB Modules: Data and Decision Science

Prof Ronan Daly

Industrial Project Supervisor

IIB Modules: Production Technologies and Materials

Prof Michaël De Volder

Industrial Project Supervisor

IIB Modules: Production Technologies and Materials

Prof Steve Evans

IIB Modules: Sustainable Manufacturing

Dr Niamh Fox

IIB Modules: Production Technologies and Materials

David Leal-Ayala

IIB Module: Enterprise, Globalisation and Policy

Dr Mark Khater

IIB Modules: Strategy and Marketing

Dr Mukesh Kumar

Industrial Project Supervisor

Prof Tim Minshall

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

Dr Veronica Martinez

Industrial Project Supervisor

IIB Modules: Strategy and Marketing, Sustainable Manufacturing

Dr Letizia Mortara

Industrial Project Supervisor

IIB Modules: Technology and Innovation Management

Prof Duncan McFarlane

Industrial Project Supervisor

IIB Modules: Manufacturing Systems Engineering;

Prof Bill O'Neill

Industrial Project Supervisor

IIB Modules: Production Technologies and Materials

Prof Ajith Kumar Parlikad

Industrial Project Supervisor

METIIB Chair of Examiners

IIB Modules: Advanced Operations Management

Dr Rob Phaal

IIB Modules: Technology and Innovation Management

Dr Sebastian Pattinson

Industrial Project Supervisor

IIB Modules: Production Technologies and Materials

Prof Frank Tietze

MET IIB Course Director

Industrial Projects Coordinator

IIB Modules: Induction; Technology and Innovation Management.

Alan Thorne

Industrial Project Supervisor

IIB Modules: Manufacturing Systems and Engineering, Automation Lab

Dr Florian Urmetzer

IIB Modules: Production Technologies and Materials

Prof Chander Velu

Industrial Project Supervisor

METIIA Course Director

IfM Teaching Office Staff

Shane Strawson
Senior MET Administrator

Sally King
Senior ISMM Administrator

Hannah Smith
Teaching Office Administrator

IfM Teaching Support Staff

Lewis Grantham
Computer Officer

Giles Hainsworth
Senior Computing Technician

Chris Jennings
Workshop Technician

Simon Sennitt
Workshop Technician

MET IIB students

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 and innovate 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 taught principles in company-based industrial projects.

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 a 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 2022-2023

Week no/day	Week starting	Content
		Michaelmas Full term starts Tuesday 4 October 2022
0 Mon	3 October 2022	Induction & Enterprise, Globalisation and Policy Module **Projects**
1 Mon	10 October 2022	Strategy and Marketing
2 Mon	17 October 2022	Technology and Innovation Management
3 Mon	**24 October 2022**	**Projects**
4 Mon	**31 October 2022**	**Projects**
5 Mon	7 November 2022	Manufacturing Systems Engineering (MSE)/Robot Lab
6 Mon	14 November 2022	Robot Lab
7 Mon	21 November 2022	Data and Decision Science
8 Mon	28 November 2022	Advanced Operations Management
		Michaelmas Full term ends Friday 2 December 2022
9 Mon	5 December 2022	Robot Lab
		Lent Full term starts Tuesday 17 January 2023
0 Mon	16 January 2023	Production Technologies and Materials
1 Mon	23 January 2023	Production Technologies and Materials
2 Mon	**30 January 2023**	**Projects**
3 Mon	**6 February 2023**	**Projects**
4 Mon	13 February 2023	Sustainable Manufacturing
5 Mon	20 February 2023	Leadership and Managing People
6 Mon	**27 February 2023**	**Projects**
7 Mon	**6 March 2023**	**Projects**
8 Mon	**13 March 2022**	**Long Project planning**
		Lent Full term ends Friday 17 March 2023
		Easter Full term starts Tuesday 25 April 2023
0 Tue	25 & 26 April (TBC)	Examinations
1 Mon	**1 May – 9 June 2023**	**Projects – 6 weeks**
7 Mon	12 June 2023	Cambridge based
		Easter Full term ends Friday 16 June 2023

Industrial Project Report Hand-In Dates 2022-2023

Project Period	Latest time for delivery to MET Office	Last Date for Supervision with Project Supervisor	Date Corrected Report due into MET Office
3-day project 5 – 7 October	**Time: 8.45** **Date: Monday 10 October**	Friday 14 October	Time: 8.45 Date: Wednesday 19 October
2-week project 24 October to 4 November	**Time: 08:45** **Date: Monday** **7 November**	Friday 11 November	Time: 08:45 Date: Wednesday 16 November
4-week project 30 January to 10 February 27 February to 10 March	**Time: 08:45** **Date: Monday** **13 March**	Friday 17 March	Time: 08:45 Date: Wednesday 22 March
6-week project 1 May to 9 June	**Time: 08:45** **Date: Monday** **12 June**	Friday 16 June	Time: 08:45 Date: **Monday** **19 June**

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 for coursework, divided as follows:	
Manufacturing systems and robot lab	55 marks
Industrial projects	245 marks
300 marks for examinations, divided as follows:	
Two written papers, each marked out of 100	200 marks
Teaching Module Assessments, 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:

Industrial Project marks

Michaelmas term interim deliverables (2-week)	45 marks
Lent term interim deliverables (4-week)	80 marks
Easter term final deliverables (6-week)	120 marks
Total	**245 marks**

Teaching Module Assessments marks

Production Technologies and Materials	22 marks
Sustainable Manufacturing	13 marks
Data and Decision Science	13 marks
Technology and Innovation Management	13 marks
Strategy and Marketing	13 marks
Leadership and Managing People	13 marks
Advance Operations Management	13 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."***

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 textbooks and much of the learning comes from class and small group discussion. The assessment and examinations assume full attendance, 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 have an end of module assessment, normally in the form of a short written examination or report. The module assessments form part of the overall assessment for the year, as shown earlier in the section on: "Project, Coursework & Examination Credit for Part IIB of MET". **Students should carefully note the assessment completion/submission times for each module** as provided by the module leader during each module introduction session**.**

Module Specifications

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

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

Module Leader: Prof Frank Tietze

Other IfM staff: Dr David Leal-Ayala, Dr Jennifer Castaneda-Navarrete, John McManus

Dates: Monday 3 October 2022 – Friday 7 October 2022

Location: IfM

Assessment: Enterprise, Globalisation and Policy lectures form part of the examinable content for the end of year exam (Paper 2).

Module Learning Outcomes

By the end of the module students will:

1. Understand the structure of MET IIB and how industrial projects work, learning approaches, key dates, assessment methods, expectations and responsibilities.
2. Appreciate the range of possible methods available when undertaking research to answer different types of questions, particular during industrial projects.
3. Be aware of the applied research skills and team-based project management skills required 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.

Links to other parts of MET IIB	For Induction	Specific relevance to approaches to managing Industrial Projects
	For EGP	Provides broad context for all MET IIB modules
Links to MET IIA	For Induction	Differentiation of BA -> MEng approaches
	For EGP	Builds on foundations of 3P9, 3P10

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

Time	Monday 3 October	Tuesday 4 October	Wednesday 5 October	Thursday 6 October	Friday 7 October
0900-1030	**Induction:** Introduction, How to succeed on MET IIB, MET IIB Structure, timetable and key dates. *Frank Tietze, Shane Strawson*	**EGP:** Complex and changing industrial landscape *David Leal-Ayala*	Industrial Projects		
	Break				
1100-1230	**Induction:** Introduction to MET IIB Industrial Projects *Frank Tietze*	**EGP:** How do firms and governments respond to the changing landscape? *David Leal-Ayala*	Industrial Projects		
	Lunch				
1330-1500	**Induction:** Mapping tools for industrial projects *John McManus*	**EGP:** How policy works? From agenda setting to evaluation *Jennifer Castaneda-Navarrete*	Industrial Projects		
	Break				
1530-1630	**Induction:** Essential MET IIB skills *Frank Tietze*	Induction Project briefings from supervisors (if not agreed at another time) Travel to Induction Project companies	Industrial Projects		

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 industrial projects to answer different types of questions or rather solve certain problems. To appreciate the relative merits and weaknesses of different methods. To understand why certain conventions are helpful to create projects with impact. To know where to find more information on using different methods. To understand the importance of evidence-gathering for industrial projects, and how to apply different methods in an industrial project context.
Introduction to industrial projects in MET IIB, and some techniques methods that can be used in such projects.	To understand the role of industrial projects within MET IIB. To be aware of a range of possible mapping techniques that can be used for industrial projects; to have basic knowledge of the relative merits and weaknesses of each.
Complex and changing industrial landscape	Understanding that manufacturing is complex and must adapt to a complex, uncertain and dynamic environment.
How do companies and governments respond to the changing landscape	Understand how companies do, and might, respond to these changes and subsequent industrial transformations. Recognition of the complexities and trade-offs that companies must deal with when selecting and implementing new strategies. Understand how and why governments are responding to help companies navigate the complexity and operate in an uncertain and changing environment through industrial and innovation policies. Recognition of the complexities and trade-offs that are a feature of policy implementation.

Industrial Projects	To be aware of the key functions in a typical manufacturing organisation, 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: Dr Veronica Martinez

Other IfM staff: Dr Mark (Mohamed) Khater

Dates: Monday 10 October 2022 – Friday 14 October 2022

Location: IfM

Assessment: Strategy and Marketing lectures form part of the examinable content for the end of year exam (Paper 2).

End of module case study written analysis. Electronic submission via Moodle online submissions.

Submission Deadline: Monday 17 October 08:45 hr. BST

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.

Links to other parts of MET IIB	Sustainable Manufacturing Module	This module introduces the strategy, capabilities and business model elements that later in the Sustainable Manufacturing Module are further explained through a variety of case studies from the service and circular economy perspective.
	Leadership and Managing People	The strategy and marketing module introduce the elements of corporate and operations strategy, these are complemented by the leadership vision discussed in the Leadership and Managing People Module.

	Technology and Innovation Management	Links to the type and innovation and the implications for business and operations' strategy and marketing.
	Data and Decision Science	This module links to the data and decision science module, particularly in the way that certain simulations and optimization outputs could influence the operations strategy of businesses.
	Industry projects (2/4/6 weeks)	This module provides opportunities to apply the marketing and strategy tools such as competitor's analysis, market research and business strategies.
Links to MET IIA	3P9	The Strategy and Marketing module has some complementary elements with 3P9. 3P9 introduced the concepts of business model canvas, the value propositions, resources, capabilities and competitive criteria. These are further expanded in this module in the marketing and strategy module.
	Industry visits	The elements of marking for product design of this Strategy and Marketing Module are complemented by the MET IIA industry visits.

Strategy and Marketing - *This is a draft timetable and may be subject to changes*

Time	Monday 10 Oct	Tuesday 11 Oct	Wednesday 12 Oct	Thursday 13 Oct	Friday 14 Oct
0900–1030	**Intro 2-Week Projects** Frank Tietze + supervisors **Intro to the Module & Marketing Planning** Veronica Martinez	**Marketing** Product/Market lifecycles Veronica Martinez	**Social Media Marketing and Strategy** **Guy Peters** Formerly Ogilvy and Mather	**Business Strategy** - Resource/competency-based approach. Corporate Strategy & Operations Strategy Mark Khater	**Operations Strategy** Cont. Mark Khater
	Break				
1100–1230	**Marketing** Intended Strategy Business Planning Veronica Martinez	**Brands & Branding in the 21st Century** **Martin Dinkele** Former SVP Savanta	**Performance – Measurement**: Theory and Cases Veronica Martinez	**Business Strategy** - Resource/competency-based approach. Corporate Strategy & Operations Strategy Mark Khater	*Assessment case study preparation*
	Lunch				
1330–1500	**Marketing** *Introduction to module assessment & questions* Veronica Martinez	**Branding** **Strategic Differentiation at Adnams** **Fergus Fitzgerald** Production Dir. Adnams	Free	**Operations Strategy** Cont. Mark Khater	*Assessment case study preparation*
	Break				
1530–1700	**Product Management** **Chris O'Connor** CEO Techcomp Europe	**Branding Exercise** **Pitching new products and ideas to investors** **Martin Dinkele** **Fergus Fitzgerald**	Free	*Assessment case study preparation*	**Module Assessment Submission Date:** *17 October 2022, 08:45 hr BST*

Strategy and Marketing: Syllabus and session learning outcomes

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

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

Aaker, David (2010). *Building Strong Brands,* Pocket Books.

Bourne, M. Wilcox, Neely, A., and Platts K., (2000); "Designing, Implementing and Updating Performance Measurement System"; International Journal of Operations and Production Management, Vol. 20(7): 754-771.

De Chernatony, Leslie (2001). *From Brand Vision to Brand Re-evaluation,* Butterworth Heinemann.

Eccles, R. (1991), "The performance measurement manifesto", Harvard Business Review, January

Gray, D., Micheli, P. and Pavlov, An. (2014). *Measurement Madness: Recognizing and Avoiding the Pitfalls of Performance Measurement,* John Wiley & Sons.

Kapferer, Jean-Noël (2012). *The New Strategic Brand Management,* Kogan Paul.

Kaplan R. S. and Norton D. P. (1992); "The balance scorecard – measures that drive success'; Harvard Business Review; Jan-Feb

Kaplan, R.S. and Norton, D.P. (1996), "Linking the Balanced Scorecard to Strategy (Reprinted From the Balanced Scorecard)", California Management Review, Vol. 39, No. 1, pp. 53- 79.

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.

Lannon, Judy and Baskins, Merry (2009). *A Master Class in Brand Planning: The Timeless Works of Stephen King,* Wiley.

Martinez, V, and Kennerley, M., (2005); 'Impact of Performance Management Reviews: evidence of an Energy Provider"; Conference Proceedings Euroma; Budapest Hungry; June 19-22

Mayer-Schonberger, V. and Cukier, K. (2013). *Big Data: A Revolution That Will Transform How We Live, Work and Think*, John Murray.

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.

Siegel, E. (2013*). Predictive Analytics: the Power to Predict Who Will Click, Buy, Lie, or Die*, John Wiley & Sons.

Online Resources

Marketing

Narver, J and S. Slater, (1990), The effect of a marketing orientation on business profitability, *Journal of Marketing,* 54(4), 20-35

Kohli, A. K, and B. J Jaworski. 1990. Market orientation: the construct, research propositions, and managerial implications. *Journal of Marketing* 54 (2) 1–18.

***VIDEO. The Marketing Mix - The 4 P's of Marketing. https://www.youtube.com/watch?v=hHtJwTU9kg8

Strategy

Mintzberg, H. (1985). Of Strategies: Deliberate or emergence, *Strategic Management Journal*, 6, 257-272

Pascale, R.T. (1984). Perspective on strategy: The real story behind Honda's success, *California Management Review*, 26(3), 47-72

*** VIDEO – THE ESSENTIALS: Porter M. (2015). What is strategy? The summary. https://www.youtube.com/watch?v=3Hd88eBgkw0

*** VIDEO – Porter M. (2008). The five competitive forces that shape strategy. https://www.youtube.com/watch?v=mYF2_FBCvXw

Wheelwright S. and Hayes R. (1985). Competing through manufacturing. *Harvard Business Review*. Jan.

Hayes R and Pisano G (1994). *Beyond world class: the new manufacturing strategy*. 77-86.

Miller J. and Roth A. (1994). A taxonomy of manufacturing strategies. *Management Science*. 40 (3):285-304

Performance Measurement

*** VIDEO – 60 seconds with Dr Veronica Martinez – The Value of Performance Measurement https://www.youtube.com/watch?v=HSRpmMIZ70U

*** VIDEO – 60 seconds with Dr Veronica Martinez – Overcoming the pitfalls of performance measurement systems https://www.youtube.com/watch?v=-oik_faboJs

Martinez, V, and Kennerley, M., (2005); 'Impact of Performance Management Reviews: evidence of an Energy Provider"; Conference Proceedings Euoma; Budapest Hungry; June 19-22 https://dspace.lib.cranfield.ac.uk/bitstream/handle/1826/3069/Impact%20of%20performance%20management%20reviews-Energy%20Supplier-2005.pdf?sequence=1&isAllowed=y

Martinez V. (2005); "What is the value le of Performance measurement systems ?"https://www.researchgate.net/profile/Veronica_Martinez9/publication/228900654_What_is_the_value_of_using_performance_management_systems/links/0deec529e51f18fb24000000.pdf

MET-IIB-3: Technology and Innovation Management

Module leader: Prof Frank Tietze

IfM staff: Prof Tim Minshall, Dr Letizia Mortara, Dr Clive Kerr, Dr Rob Phaal, Dr Thomas Bohné

Dates: Monday 17 October 2022 – Friday 21 October 2022

Location: IfM

Assessment: Technology and Innovation Management lectures form part of the examinable content for the end of year exam (Paper 2).

End of module case study written analysis. Electronic submission via Moodle online submissions.

Attendance and participation in the City Car simulation.

Submission Deadline: Monday 24 October 08:45 hr.

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

Demonstrate knowledge and understanding of:

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

Demonstrate the ability to:

- evaluate technologies and innovations, and select appropriate approaches to manage them;
- apply tools and techniques to real business situations, cases and simulations;
- identify and critically analyse technology and innovation management issues;
- understand team challenges when developing new product innovations and
- appreciate the strategic relevance of intellectual property.

The module applies a set of complementary teaching and learning techniques, a set of small-group exercises (e.g. a standardization case study and strategy development using roadmapping), a one-day group simulation exercise and a high-profile guest talk by a former MET student.

Links to other parts of MET IIB		Strategy and Marketing module
		Leadership and people module

Links to MET IIA		(3P9) Industrial Economics, Strategy and Governance (Service/ BM innovation, strategy and strategic planning, firm boundaries, competition)
		(3P7) Managing Business and People (Entrepreneurship, change management, trends, competition)
		(3P10) Contemporary Issues in Manufacturing
		Other links: Design project, (3P6) Organisational behaviour

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

	Monday 17 October	Tuesday 18 October	Wednesday 19 October	Thursday 20 October	Friday 21 October
0900-1045	Introduction to Long Projects Module introduction *Frank Tietze*	Strategic technology management *Rob Phaal and Myron Johnson (Johnson Matthey)*	Technology intelligence *Letizia Mortara*	Introduction to NPI + City car simulation *Thomas Bohné + team*	From Racetrack to road and off again – commercialising technology *James Colgate from Williams Advanced Engineering*
Coffee					
1100-1230	Evolution of industries, technologies and markets *Tim Minshall*	Technology Roadmapping *Rob Phaal*	Technology selection *Clive Kerr*	City car simulation *Thomas Bohné + team*	Coursework preparation
Lunch					
1330-1500	ISAEP model *Tim Minshall*	Open innovation *Tim Minshall*	Free	City car simulation/ Coursework preparation	Coursework preparation
Tea					
1515-1700	Technology protection and exploitation *Frank Tietze*	Technology acquisition and identification *Letizia Mortara*	Free	Coursework preparation	**Module assessment Submission date: Monday 24 October Time: 08:45**

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
Technology protection/ exploitation	Appreciate the importance of intellectual property management and strategy to protect technologies and maximize value capture from innovations and novel technologies To understand the complexities of IP in the development, exploitation (diffusion and commercialisation) of innovative technologies
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 Understand what it takes to create 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 acquisition / identification	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. Aspects of identifying novel technologies.

	Develop assessment criteria for the acquisition of early stage technologies
Technology intelligence	Describe the importance and challenges firms face in monitoring threats and opportunities from new technologies Understand some of the basic approaches for monitoring the changing technology landscape
Technology selection	To understand the challenges and approaches for selecting technologies that are relevant for ensuring companies continue to innovate and maintain competitive advantage
City car simulation	To experience in a group setting the challenges, technical and managerial, associated with the development and introduction of novel/innovative products
Industry guest speaker	Providing an industry perspective on key concepts discussed during the previous lectures on technology and innovation management
Module assessment	Demonstrate understanding of key module concepts

Reading list

Aristodemou, L., F. Tietze and M. Shaw (2020). Stage Gate Decision making: a scoping review of Technology Strategic Selection Criteria for Early Stage Projects. IEEE Engineering Management Review 48(2): 118-135.

Blümel JH, Tietze F, Phaal R. Formulating IP strategies for service-intense business models: A roadmapping-based approach. World Patent Information. 2022;70.

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

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

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

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

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

Tietze, F., P. Vimalnath, L. Aristodemou and J. Molloy (2020). Crisis-Critical Intellectual Property: Findings from the COVID-19 Pandemic. IEEE Transactions on Engineering Management.

Tietze F, Phaal R, Bluemel J, Wang T. (2022) Roadmapping for formulating IP Strategies. In: CTM working paper series. Cambridge, UK.

Vimalnath P, Tietze F, Jain A, Gurtoo A, Eppinger E, Elsen M. (2022) Intellectual property strategies for green innovations - An analysis of the European Inventor Awards. Journal of Cleaner Production.

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

Technology Roadmapping
http://www.ifm.eng.cam.ac.uk/roadmapping/

Technology Intelligence
http://www.ifm.eng.cam.ac.uk/research/ctm/techintelligence/

Open Innovation

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

Intellectual Property Management and Strategy
www.ifm.eng.cam.ac.uk/iipm

Various research papers from the Centre for Technology Management are available in the centre's working paper series:

www.ifm.eng.cam.ac.uk/research/ctm/ctmpublications/ctmworkingpapers/

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, Prof. Duncan McFarlane

Other IfM staff: Simon Sennitt, Chris Jennings, Dr Zhengyang Ling

Dates: Taught Component: Monday 07 – Friday 11 November 2022
Practical Component: Monday 14 – Friday 18 November 2022;
Monday 5 – Friday 9 December 2022

Location: Taught Component: Face to Face
Practical Component will be a mix of:

- Face to Face
- Timed lab slots in the Automation Laboratory, Alan Reece Building. (Full details of lab access times is provided in lab handbook)
- 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%), Final Presentation (10%), Final Integrated Solution & Demonstration (20%).

Electronic submission via Moodle Submissions

Submission Deadline for report: Monday 9 January 2023 - 08:45 GMT

Manufacturing Systems Engineering lectures form part of the examinable content for the end of year exam (Paper 1).

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

Module Learnings 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 will enable an automation system to be developed within the automation lab. This will be through the configuration and programming of existing automation equipment within the lab (Robots, Conveyors & Machine Tools). Additional bespoke automation components required such as (Fixtures, Feeders & End Effectors…) will also be designed and developed. The overall control of the automation system will be performed by an industrial programmable logic controller (PLC).

The practical exercise 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 one's self, 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. If at any point you have questions or concerns around these procedures please talk to a member of staff.

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

		Morning			**Afternoon**	
Monday 7 November	**09:00** **09:15-** **10:45** **11:15-** **13:00**	Introduction Planning Systems Integration Manufacturing Execution Systems ISA 95	Alan Thorne / Duncan McFarlane Tim Mead Innomech Ltd. Gary Hilton Boeing (UK)	**14:00-** **15:00** **15:00-** **15:30** **15:30-** **17:00**	Introduction to Robot Lab Exercise Lab. Safety Talk – H&S questionnaires Robot Lab Planning, definition of groups	Alan Thorne / Simon Sennitt Alan Thorne / student teams
Tuesday 8 November	**09:00-** **9:45** **10:00-** **12:30**	Introduction to Programmable Logic Controllers (PLC's) Breakout Activity [2 Groups ½ of MET] Exercise PLC programming (Grp. 1) PLC Technologies/Case Studies (Grp. 2)	Justin Baker Omron Alan Smith Omron Justin Baker / Alan Smith	**14:00-** **16:00**	Exercise PLC programming (Grp. 2) PLC Technologies/Case Studies (Grp. 1) Questions	Justin Baker/ Alan Smith Omron
Wednesday 9 November	**09:00-** **10:45** **11:00-** **11:40** **11:50-** **13:00**	Integrated Manufacturing Systems: CNC Machines Tools, FMS and Automated Machining Systems Automation Solutions: Market Trends, Philosophies and Technologies Exercise – Automated component manufacture (Group 1 / 2 / 3)	Mark Hall mazaki Mazak (UK) Mike Sykes mazaki Mazak (UK) Mike Sykes Yamazaki Mazak (UK)		**Free**	
Thursday 10 November	**09:00-** **09:45-** **10:30** **11:00-** **11:50** **12:00-** **13:00**	Sensors in Automation Fixtures and End effectors Cell control and system test Industrial IOT	Alan Thorne Alan Thorne Duncan McFarlane	**14:00-** **14:45** **14:45-** **15:15** **16:00-** **17:30**	Low Cost Digital Solutions: Digital Manufacturing on a Shoestring Introduction to Low Cost Vision Systems Exercise – Low Cost Vision Exercise / Open CV Programming exercise	Duncan McFarlane Zhengyang Ling Zhengyang Ling
Friday 11 November	**09:00-** **10:30** **11:00-** **13:00**	Warehouse Services / Automation Pneumatic Systems in Automation	Dave Swan Tharsus Nick Watson SMC Pneumatics (UK)	**14:00-** **15:15** **15:45-** **17:00**	Introduction to Robotics Introduction to Off-line robot programming	Alan Thorne Alan Thorne

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

		Morning			Afternoon	
Monday 14 November	**09:00- 13:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling	**14:00- 17:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling
Tuesday 15 November	**09:00- 13:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling	**14:00- 17:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling
Wednesday 16 November	**09:00- 13:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling	**14:00- 17:00**	**ROBOT LAB**	
Thursday 17 November	**09:00- 13:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling	**14:00- 17:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling
Friday 18 November	**09:00- 13:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling	**14:00- 17:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling

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

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

		Morning		Afternoon	
Monday 5 December	**09:00-13:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling	**14:00-17:00**	**ROBOT LAB** Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling
Tuesday 6 December	**09:00-13:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling	**14:00-17:00**	**ROBOT LAB** Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling
Wednesday 7 December	**09:00-13:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling	**14:00-17:00**	**ROBOT LAB**
Thursday 8 December	**09:00-13:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling	**14:00-17:00**	**ROBOT LAB** Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling
Friday 9 December	**09:00-13:00**	**ROBOT LAB**	Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling	**14:00-16:00**	**Presentations / Wrap-up** Alan Thorne Duncan McFarlane Chris Jennings Simon Sennitt Zhengyang Ling

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

Manufacturing Systems Engineering - Syllabus and session learning outcomes

(Note <u>all lecturer</u> material within the MSE module is examinable)

Syllabus	Session learning outcomes
Planning Systems Integration Managing large projects. Stages of planning and implementation. Functional specifications. Typical problems with integration and how to avoid/solve them.	Know and understand the stages of planning and implementing integrated manufacturing systems, including the major pitfalls and how to avoid them. Write a simple functional specification for an automated system. Appreciate and be able to manage the effect of changes during design and implementation.
Introduction to Robot Lab Aims of the practical sessions. Description of the tasks. Organisation and methods of working. Risk assessment. Health and safety considerations. Methods of staff support. Methods of assessment.	Understand the practical task, the methods of operation, and the methods of assessment to be used. Carry out risk assessments, and to install and maintain safe working practices.
CNC Machine Tools, FMS, Automated Machine Systems Types of CNC machine tool. Benefits of multiple axis machines, esp 5,6 axis. Types of tooling and sensing. Automated methods of loading. Minimally manned operation. 'Make complete in one' Machine from solid vs forge/cast and machine.	Know the state of the art in CNC machining and Flexible Automated Manufacturing Systems. Understand current industrial needs, practical applications and automated solutions. Relate automated solutions to business needs.
Introduction to Automation / Robotics What is Automation (Definitions) Automation Benefits / Challenges Types of robots. Benefits of different axis configurations. Types of end effector. Sensing. Software enhancements – soft float, force feedback etc. Vision systems and robotics. Multiple robot systems.	Definitions of Automation from Oxford dictionary and Automation Federation. Understand the benefits that automation can provide as well as the challenges that need to be considered in implementing solutions. 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 sensors. 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.
Pneumatic Systems in Automation Overview of infrastructure components required to deliver pneumatic / vacuum solutions. (Compressors, Dryers, Storage, Regulation) Overview of control and actuation components. (Valves, Regulators, Actuation Cylinders, Grippers, Suckers) Basic component symbology and circuit layouts. Transformational technologies supporting / impacting pneumatic solutions.	Understand what the key components are that would be required in implementing a pneumatic solution in an industrial environment. Basic understanding of control and actuation components that would be required in the controlled operation of a fixture / robot end effector. Use of standard pneumatic circuits and symbology to describe the operation of a pneumatic system. (Clamping components of a fixture)

Industrial IOT Overview of industrial IOT. What is IOT, where did it come from and how does it work with IT Systems. Examples of how different companies are implementing and benefiting from IOT; Flour, Unilever, Rolls Royce and Mazak.	Understand what IOT is and in what situations it can be useful to an organisation.
Low Cost (Automation) Digital Solutions Overview of global digital manufacturing initiatives. Challenges that are faced by SME's in adopting these initiatives. Examples of low-cost digital solutions (Application Areas) that can provide benefits to SME's. Overview of the Shoestring research project. Investigating how low-cost consumer technologies and software development environments can support SME's manufacturing needs.	Understand what digital manufacturing initiatives are being carried out around the world. Examples of low-cost digital solutions (Application Areas) that can provide benefits to SME's. Objectives of the Shoestring research project and the types of consumer electronics being introduced to the manufacturing applications.

MET-IIB-5: Data and Decision Science

Module Leader: Prof Ajith Parlikad

Other IfM staff: Dr Timos Kipouros, Jack Foster, Edward Kosasih, Dr Alex Yoo, Jaime Macias Aguayo

Dates: Monday 21 November – Friday 25 November 2022

Location: IfM

Assessment: Data and Decision Science lectures form part of the examinable content for the end of year exam (Paper 1)

Electronic submission via Moodle online submissions

Submission Deadline: Monday 12th December 2022 - 08:45 GMT

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

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

Links to other parts of MET IIB		Links to industrial problem settings and Industry 4.0 concepts discussed in Advanced Operations Management.
Links to MET IIA		Advances concepts taught in 3P4 such as risk and variability in supply chains and factory operations.

Data and Decision Science *This is a draft timetable and may be subject to changes*

Time	Monday 22 Nov	Tuesday 23 Nov	Wednesday 24 Nov	Thursday 25 Nov	Friday 26 Nov
0900-1030	Introduction to module Ajith Parlikad	Neural Networks Edward Kosasih, Jack Foster	Introduction to Optimisation Timos Kipouros	Optimising business decisions – Practical session Alex Yoo, Jaime Macias Aguayo	Discrete Event Simulation Ajith Parlikad
Coffee					
1100-1230	Sampling Practical Timos Kipouros	Neural Networks Edward Kosasih, Jack Foster	Multi-objective Optimisation and Optimisation with Heuristics Timos Kipouros	Optimising business decisions – Practical session Alex Yoo, Jaime Macias Aguayo	Discrete Event Simulation Ajith Parlikad
Lunch					
1330-1500	Business analytics: Multiple Regression analysis Timos Kipouros		Self-study/ Office hour Timos Kipouros	Self-study/ Office hour Alex Yoo, Jaime Macias Aguayo	Self-study/ Office hour Ajith Parlikad
1500-1630					**Module assessment Submission Date: Monday 12 December Time: 08:45 hr GMT**

Data and Decision Science - Session syllabus and learning outcomes

Introduction	Appreciate the range of logical and structured applications of modern data analytics methods and their role in supporting decision making in business
Sampling	Explore the basics of sampling data and appreciate how sampling can be used through a hands-on case study.
Regression analysis	Learn to construct single and multiple regression models, and how to interpret model outputs
Optimisation	Learn how to formulate single and multi-objective optimisation problems Understand the range of Heuristic and nature-inspired methods applied to optimization problems. Learn how to structure and solve optimisation problems in operations management
Neural networks	Learn about the fundamentals of Neural Networks, what problems they are appropriate for, and practice using Neural Networks through a hands-on session.
Discrete Event Simulation	Understand the fundamentals of simulating a manufacturing operation Learn how to use Arena to develop a simulation model and analyse the results

Reading List

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

Additional readings will be provided on Moodle.

MET-IIB-6: Advanced Operations Management

Module Leader: Prof Ajith Parlikad

Other IfM staff: Prof Duncan McFarlane, Dr Mukesh Kumar, Dr Veronica Martinez, Dr Maharshi Dhada, Darius Danaei

Dates: Monday 29 November – Friday 3 December 2021

Location: IfM

Assessment: End-of-Module Coursework

Electronic submission will be via Moodle online submissions

Submission Deadline: TBC

Advanced Operations Management lectures will form part of the examinable content for the end of year exam.

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

1. Discuss the key issues and challenges involved in the management of industrial operations
2. Understand the principles of and the practical challenges involved in industrial logistics and warehousing operations
3. Identify and analyse the risks involved in the management of complex supply chains
4. Carry out basic project planning and understand the fundamentals of project risk management
5. Discuss the concept of servitization and the key differences between manufacturing and service operations

Links to other parts of MET IIB		Applies concepts of optimization and data analytics from the Data and Decision Science module to Operations Management
		The lectures on servitisation will have links to the material covered in the Strategy & Marketing Module
Links to MET IIA		3P5 – Maintenance Engineering; Facility Layout Planning; Lean Manufacturing
		3P4 – Supply chain management; Inventory Management
		3P2 – Statistical Process Control

Advanced Operations Management *This is a draft timetable and may be subject to changes*

Time	Monday 29 Nov	Tuesday 30 Nov	Wednesday 1 Dec	Thursday 2 Dec	Friday 3 Dec
0915-1030	Operations Management – Introduction Ajith Parlikad	Logistics Management: Industrial speaker Glovo	Supply chain and logistics management: Industrial speaker Ocado	Supply Chain Game Maharshi Dhada / Ajith Parlikad	Services in Practice (TBD)
Coffee					
1100-1230	Project Management Ajith Parlikad	Temporary logistics operations Darius Danaei	Supply chain and logistics management: Industrial speaker Tesco	Supply Chain Game Maharshi Dhada / Ajith Parlikad	The future of services with digital Veronica Martinez
Lunch					
1330-1500	Industrial Logistics Maharshi Dhada	Supply chain risk and resilience Mukesh Kumar	Free	Introduction to Services and Service Design Veronica Martinez	Free
Break					
1515-1700	Industrial Logistics Maharshi Dhada	Supply chain risk and resilience: Industrial speaker Porsche	Free	Customer Service Journey and Operations Veronica Martinez Services in Practice: Service business model innovation Veronica Martinez	Free

Advanced Operations Management - Session syllabus and learning outcomes

Lecture	Learning outcomes
Operations Management: Introduction	Understand the key issues and challenges in industrial operations management Recap of relevant MET IIA material
Project Management	Learn the fundamentals of project management – Project Planning, GANTT Charts, Project Evaluation and Review Technique (PERT), Critical Path Method, (CPM), Project Resource Planning, Activity crashing Learn how to quantify and manage uncertainties and risks in projects
Industrial Logistics	Understand the challenges in designing and managing a logistics system Learn how data analytics and machine learning is applied in industry to manage complex logistics operations
Temporary logistics operations	Understand the challenges in and the process of rapid setting up of temporary logistics operations
Supply chain risk and resilience	Learn how to identify key risks in industrial supply chains Understand the interdependencies between different types of supply chain risks Learn different approaches for quantifying and analysing risk in supply chains
Data analytics in supply chain management	Discuss how quantitative approaches may complement and are influenced by practical and business issues relating to supply chain management.
Supply chain game	Understand the dynamics that emerge along a supply chain Discuss strategies to overcome adverse emergent effects
Introduction to Services and Service Design	Understand the economic, strategic and environmental rationales of why manufacturing companies are servitizing Understand the concept of servitization and the key differences between manufacturing and services Understand the five phases of service design thinking, particularly focus on understanding customer/user needs Understand the service – concept, experience and outcome framework

Customer service journey and business model innovation	Understand the journey to service from the customers/ users perspective and correspondent set of operations Understand the service business model innovation concept and examples
The future of services with digital	Learn the trends and future of services and the role of digital technology in effective delivery and management of services

Additional readings will be provided on Moodle.

MET-IIB-7: Production Technologies and Materials

Module Leaders: Prof Ronan Daly

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

Dates: Monday 16 January – Friday 27 January 2023

Location: IfM

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

Module assessment, Thursday 26 January 2023, 09:00 hr. GMT

Group report, electronic submission via Moodle

Submission Deadline: Monday 30 January 2023; 08:45 hr. GMT

Production Technologies and Materials lectures form part of the examinable content for the end of year exam (Paper 1).

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

Links to other parts of MET IIB		METIIB-4 (assembly, automation, manufacturing systems), METIIB-7 (sustainable manufacturing), Industrial Projects (considering broad influences on manufacturing on products and systems)
Links to MET IIA		3P1, 3P10 (Polymers, composites), 3P2 (production technology control), 3P3 (design for manufacture/assembly), 3P10 (sustainability, biopolymers, medical technology manufacture)

PTM – Week 1 *This is a draft timetable and may be subject to changes*

Time	Monday 16 January	Tuesday 17 January	Wednesday 18 January	Thursday 19 January	Friday 20 January
0900 – 1030	*Introduction to module and to assignment* *Ronan Daly*	Production Technologies -Assembly 1 Assembly & automation *Alan Thorne*	Production Technologies -Additive 1 Introduction & AM with polymers *Sebastian Pattinson*	Production Technologies -Ultraprecision 1 Introduction & overview Paul Shore	Materials -Polymers 1 Injection moulding *Florian Urmetzer*
10:45 – 12:15	Production Technologies -Chemical processes 1 Chemical process industry *Ronan Daly*	Production Technologies -Assembly 1 Assembly & automation *Alan Thorne*	Production Technologies -Additive 2 Metal AM and High Powered Lasers *Bill O'Neill*	Production Technologies -Ultraprecision 2 Laser technologies *Jack Gabzdyl*	Materials -Polymers 2 Polymer characterisation & advanced applications *Niamh Willis-Fox*
	Lunch				
1330 – 1500	Production Technologies -Chemical processes 2 Continuous processes *Andrew Rutter*	Production Technologies -Assembly 2 Superconducting magnets *Melanie McGregor*	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group work**	Materials -Polymers 3 Biopolymers *Claire Barlow*
	Break				
1515 – 1645	Production Technologies -Chemical processes 3 Adhesives *Stuart Thompson*	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group work**

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

Time	Monday 23 January	Tuesday 24 January	Wednesday 25 January	Thursday 26 January	Friday 27 January
0900- 1030	Materials -Advanced Materials 1 High performance materials & biomimetics *Ronan Daly*	Materials -Carbon Fibre 1 Carbon fibre and composite manufacturing *Benjamin Wood*	**PTM Assignment:** **Group work**	**<u>Module Assessment</u>** **(09:00 – 10:00)**	**PTM Assignment:** **Group presentation**
	Coffee				
1045-1215	Materials -Advanced Materials 2 Carbon nanotubes *Michael de Volder*	Materials -Carbon Fibre 2 Carbon fibre composite applications in F1 *Steve Foster*	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group presentation**
	Lunch				
1330- 1500	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group presentation**
	Tea				
1515-1645	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group work**	**PTM Assignment:** **Group presentation**

Production Technologies and Materials – Syllabus and session learning outcomes

Syllabus	Session learning outcomes
Production Technologies **Chemical Processes 1: Chemical Process Industry & Technologies** Definition and categorization of chemical process industry Characteristics of Primary and Secondary manufacturing Characteristics of Continuous and Batch processes The steps in chemical process design How to carry out a hazard and operability study Example unit operations and reactors	Appreciate the range of industries linked to chemical processes Understand the choice between continuous and batch manufacturing based on current practice Develop basic design skills for chemical processes
Production Technologies **Chemical Processes 2: Continuous processes** Current manufacturing technology in the pharmaceutical industry The drivers for change in manufacturing Unit operations, batch and continuous manufacturing technologies in the pharmaceutical industry 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 or a mix of batch/continuous manufacturing Understand the links between the broader supply chain and manufacturing choices
Production Technologies **Chemical Processes 3: Adhesives and bonding** Chemistry of adhesives and the batch manufacturing routes for their production Background to the application of advanced adhesives Principal applications of industrial adhesives Approaches taken to testing adhesive properties Considerations when choosing between adhesives for different applications. 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

Production Technologies **Assembly 1: Assembly & Automation** The relationship between product characteristics and assembly method: volume/complexity Overview of different assembly system configurations The advantage/disadvantages of hard/soft automated systems 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
Production Technologies **Assembly 2: Superconducting magnets** Design, materials selection and manufacturing processes for high-field superconducting magnets for medical imaging applications Supply chain and quality issues Assembly challenges	Describe the particular logistic, scheduling and technical problems of manufacture and transport of these very large, high precision devices
Production Technologies **Additive 1: Introduction & AM with polymers** Fundamental rapid prototyping concepts for the production of 3D objects, with a focus on polymers and metals Application in design and production Additive manufacturing concepts and the drive for higher throughput and 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 as compared with standard manufacturing approaches
Production Technologies **Additive 2: Metal AM and High Powered Lasers. Additive manufacturing systems** Key techniques for metal additive manufacturing at industrial scale, materials challenges in metal AM Process challenges in metal AM, Industry applications and case studies Future challenges facing broader adoption of AM	Able to describe steps in each production technology noted by Renishaw Understanding the challenges and limitations in metal AM

Production Technologies **Ultraprecision 1: Introduction & overview** Ultra-precision production technologies Definition of ultra-precision manufacturing Manufacturing processes at the very small scale, their characteristics and limitations Build an understanding of a range of micro and nano manufacturing ultra-precision techniques including a range of lithographic, roll-to-roll printing and ion-beam approaches	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
Production Technologies **Ultraprecision 2: Laser technologies** Advanced processes – laser technologies 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 Future developments of laser technology	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 materials for manufacturing applications Understand the basic laser based manufacturing techniques and technologies Appreciate where and how industrial lasers may replace traditional manufacturing technologies
Materials **Polymers 1: Injection moulding** Injection moulding basics Machine setup (how do they work?) Forms, flow analysis Potential quality issues Other processes: Bottle blowing and filling	Understand concept of injection moulding Comprehend the process of injection moulding Appreciate problems with the process Know basic quality aspects
Materials **Polymers 2: Polymer characterization and advanced applications** Definitions, properties and applications of advanced polymers Characterisation techniques to interrogate polymer properties	Understand the changing role of polymers in industry Understand the basics of sampling, measuring and validating polymer materials

Materials **Polymers 3: 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
Materials **Advanced Materials 1: High performance materials & biomimetics** Discussion of definition of 'high performance' Examples of materials with these attributes for particular applications Discussion of looking to nature for inspiration when creating high performance materials Examples of biomimetic materials and the reasons for their high performance characteristics	Appreciate the range of material properties that may need to be optimized for engineering applications Understand the principles behind some examples of material property optimisation
Materials **Advanced Materials 2: Carbon Nanotubes (CNT) and their applications** Structure, properties, synthesis and processing of CNTs Applications and market development Safety	Understand the manufacturing processes, properties and a range of potential applications of CNTs
Materials **Carbon Fibre 1: Carbon fibre and composite manufacturing** Manufacturing process steps when fabricating core, carbon fibre and prepreg Applications for carbon fibre and associated materials and processes to fabricate 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

<u>Materials</u> **Carbon Fibre 2: Carbon Fibre Composites – F1 applications** Materials selection and design for high performance racing cars Quality assurance and testing Process steps when fabricating components from carbon fibre composites	Describe and justify the range of applications of carbon fibre composites and other advanced materials in Formula 1 racing car design Understand the materials processing methods used and the reasons for their selection

Production Technologies and Materials - Module Assignment

Objective

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

Module Context

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

Assignment Activities and Process

Students are grouped into teams of four or five. Each team is allocated a product.
The challenge is for the team to undertake an analysis of the product design, materials choice, the manufacturing system capable of producing it and the business context in which it is manufactured. The results of each project group are presented in a debrief to the class at the end of the module and a submitted report. Details of the brief and the assessment criteria are presented on Day 1 of the module.

Debrief

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

Report

Each group presents a short report that summarises their findings during the course of the assignment. Electronic copies of the reports are to be summited to the Course Leader use Moodle Submissions by 08.45hr on Monday 30 January

MET-IIB-8. Sustainable Manufacturing

Module leaders: Dr Veronica Martinez

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

Dates: Monday 13 February – Friday 17 February 2023

Location: IfM

Assessment: Sustainable Manufacturing lectures form part of the examinable content for the end of year exam (Paper 1 and Paper 2).

Written case study assessment

Electronic submission via Moodle online submissions

Submission Deadline: Monday 20 February 08.45hr GMT

Module Learning Outcomes

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

- What is meant by sustainability in an industrial context
- The drivers of and barriers to sustainable manufacturing
- Systems approaches to sustainability
- How businesses may respond to the sustainability challenge
- Critical materials and sustainability

Links to other parts of MET IIB	Strategy and Marketing	The economical, ecological and social principles of sustainability have implications in the corporate and operations strategy and marketing
	Production Technology and Materials	Links to product design, sustainable materials and sustainable manufacturing processes. Links to disassembly and the repurposing strategy of the circular economy
Links to MET IIA	3P5	3P5 introduces the concepts of maintenance and scheduling maintenance, both important to the recycling, repurposing and circular business models of this module

	3P10	The 4 lectures on Sustainability provide foundation knowledge for industrial ecology and other relevant matters relating to sustainable manufacturing
	Industry Visits	The elements product design for sustainable products brands of this Strategy and Marketing Module are complemented by the MET IIA industry visits The 'sustainability' theme in the visits program provided real-life examples of approaches to sustainable manufacturing in different sectors

Sustainable Manufacturing *This is a draft timetable and may be subject to changes*

Time	Monday 13 February	Tuesday 14 February	Wednesday 15 February	Thursday 16 February	Friday 17 February
0900-1030	Module Introduction Industrial Sustainability *Veronica Martinez*	Energy and Life Cycle Assessment *Stuart Scott*	Eco-efficiency and the Circular Economy *Mélanie Despeisse*	Imperfect World: Sustainability in Real Factories *Daniel Summerbell carbonre.tech*	Case study: AB Sugar Wissington *Gary Punter AB Sugar Wissington*
Coffee					
1100-1230	Value Explorer Tool *Ian Bamford*	Packaging and Sustainability *Claire Barlow*	Improving Sustainability *Rob Crawford Chartwell*	Imperfect World: Sustainability in Real Factories *(continued)* *Daniel Summerbell*	Blockchain and the Circular Economy *Neo C. K. Yiu Klaytn Foundation*
Lunch					
1330-1500	Sustainable Service Business Models *Veronica Martinez*	Critical Materials and Sustainability *Claire Barlow Veronica Martinez*	Free	13.30-15.30 Imperfect World: Sustainability in Real Factories *(cont.)* *Daniel Summerbell*	*Module Assessment Preparation*
Tea					
1530-1700	*Module Assessment Introduction* *Veronica Martinez*	*Module Assessment Preparation*	Free	*Module Assessment Preparation*	*Module Assessment Submission Date:* *20 February 2023 08:45 hr GMT*

Themes: **Urgency and need**; Introduction to tools & assessment method; Application of tools & assessment method; Real world case studies

Note: Please sign up to sessions for the Imperfect world: sustainability in the real factories by Dr Summerbell

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
Critical Materials and Sustainability	Environmental impact of materials production, basis for predictions of scarcity, mitigation measures. Digital technologies that help the management and reuse of critical materials.
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
Eco-Efficiency and the Circular Economy	Describe concepts, strategies and principles for sustainability, apply eco-efficiency and circularity at factory level Recognize implementation challenges and how to overcome them
Imperfect World: Sustainability in Real Factories	Approaches and methods to quantify approximate potential improvement, including Zero Loss Yield and Sustainability by Design concepts
Sustainable business innovation	An overview of how businesses can innovate their business models towards sustainability introducing industry proven tools (e.g. Value Explorer) to better understand sustainable value and business transformation
Improving Sustainability	Approaches and methods that can lead to sustainability improvement in factories

Reading List

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
GAIARDELLI P., RESTA B., MARTINEZ V., PINTO R., ALBORES P.	A *classification model for product-service offerings; Journal of Cleaner Production. 2014. 66: 507-519*
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
MARTINEZ V., ZHAO M., BLUJDEA C., HAN X., NEELY A. AND ALBORES P.	Bl*ockchain-driven customer order management. International Journal of Operations & Production Management, 39 (6/7/8): 993 1022. https://doi.org/10.1108/IJOPM-01-2019-0100*
RANA S., SHORT S. W., EVANS S.	An Industrial Case: Riversimple. In: Liyanage J., Uusitalo T. (eds) *Value Networks in Manufacturing. Springer Series in Advanced Manufacturing.* Springer, (2017) *Cham. https://doi.org/10.1007/978-3-319-27799-8_10*
SABERI S., KOUHIZEDEH M., SARKIS J. AND SHEN L.	Blockchain technology and its relationships to sustainable supply chain management, International Journal of Production Research, 57:7, 2117-2135, (2019) DOI: 10.1080/00207543.2018.1533261

TKACZYK A. H., et al. *Sustainability evaluation of essential critical raw materials: cobalt, niobium, tungsten and rare earth elements. J.Phys. D: Appl. Phys. 51: 203001. (2018) https://iopscience.iop.org/article/10.1088/1361-6463/aaba99/pdf*

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 Journal of Cleaner Production, 2017. 40 (3), 1794-1804*

MET-IIB-9: Leadership and Managing People

Module leader: Prof Tim Minshall

External speakers: Dr Victor Christou; Pieter Knook; Dr Catherine Tilley; Dr Man-Hang Yip; Daniel Northam Jones

MET alumni panel members: TBC.

Dates: Monday 20 February – Friday 24 February 2023

Location: **IfM**

Assessment: Written analysis of case study situation

Submission Deadline: Monday 27 February 2023; 08:45 hr. GMT

Leadership and Managing People lectures form part of the examinable content for the end of year exam (Paper 2)

Module Learning Outcomes

By the end of the module the students will:

1. Be able to demonstrate understanding of selected core theories that underpin the management of people and the role of leadership, and their relative strengths and weaknesses, building on the foundations provided in MET IIA.
2. Understand how your own leadership and management capabilities can be developed throughout your career.
3. Understand how different leadership and management approaches are used in different contexts, ranging from start-ups to multinationals, and commercial to academic/policy organisations.
4. Appreciate the evolving range of people-related issues that can occur as firms grow and when implementing change, and have a basic understanding of key approaches to change management in different contexts.
5. Be aware of the people-related challenges of dealing with significant technological change from national level policy and firm level management perspectives.
6. Understand the role of people in successful business collaborations and, in particular, issues of trust and contracts.
7. Be aware of the messy practical details of leadership and people management.

Links to other parts of MET IIB	EGP	How companies and governments respond to disruptions
	TIM	Technology acquisition; open innovation
	S&M	Leadership; strategic decision making
Links to MET IIA	3P6	Culture, motivation, leadership, change management
	3P7	Opportunity cycle of enterprise; Recruiting, motivating, measuring, developing, retaining

Time	Monday 20 Feb	Tuesday 21 Feb	Wednesday 22 Feb	Thursday 23 Feb	Friday 24 Feb
0900-1030	Module introduction. *Tim Minshall* **Panel discussion:** Leadership and managing people experiences from ex-METs: *TBC.*	Leadership and management issues in start-up companies. *Dr Victor Christou (VC investor & entrepreneur)*	How to continuously develop your leadership capabilities and lead change. *Dr Catherine Tilley (ex McKinsey, KCL)*	Management of people in partnerships and collaborations Management of change at the national level for new technologies *Tim Minshall*	Coursework preparation.
Coffee					
1100-1230	Review of core theories on leadership, managing people, and change management. Assessment briefing *Tim Minshall*	Leadership and management issues in multinational corporations. *Pieter Knook (ex Microsoft, ex Vodafone)*	Leadership and management in during extreme growth and high uncertainty. *Dr Man-Hang Yip (Amazon) and Daniel Northam Jones (NHS)*	Module summary Student-requested topics *Tim Minshall*	Coursework preparation.
Lunch					
1330-1700	**13:30 - 14:00** Daily Q&A Session **14:00 - 17:00** Module readings and assessment preparation	**13:30 - 14:00** Daily Q&A Session **14:00 - 17:00** Module readings and assessment preparation	**13:30 - 14:00** Daily Q&A Session **14:00 - 17:00** Module readings and assessment preparation	**13:30 - 14:00** Daily Q&A Session **14:00 - 17:00** Module readings and assessment preparation	**Module assessment Submission Date:** **Monday 27 February** **Time: 08:45 GMT**

Leadership and Managing People – Session syllabus and learning outcomes

Syllabus	Learning Outcomes
Introduction Assessment briefings	To understand what will be covered in this module. To understand how this module will be assessed.
Panel Discussion: Why this stuff <u>really</u> matters in different contexts.	To appreciate the 'real world' importance of this material, how different people approach these issues in different ways, and how others have developed their leadership and management capabilities.
Review of core theories	To be reminded of the core theories from MET IIA that underpin real world leadership, people management, and change management.
Leadership and management issues in start-up companies **Leadership and management issues in multinational corporations** **Leadership and management in conditions of extreme uncertainty and during extreme growth**	To understand the role and tools of management and leadership in smaller, early-stage organisations large complex organisations, in firms experiencing 'hyper-growth', and in organisations facing extreme uncertainties.
Developing your continuously leadership capabilities and lead change	To be aware of different ways you can: develop your leadership and management capabilities over your career(s); develop and make best use of networks (mentors, mentees and supporters); maintain learning; and seek out new challenges.
Management of people in partnerships and collaborations	To be aware of the specific people management issues in successful business collaborations and, in particular, issues of trust, contracts and relationship management.
Leadership of change at scale for new technologies	To be aware of the leadership and people / skills-related challenges when attempting to support the diffusion of a new technology at scale.

Reading List:
Module readings provided on Moodle.

Industrial Projects

Introduction

Industrial projects are a distinctive feature of METIIB 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.

METIIB industrial projects consist of two team-based projects (one each in Michaelmas and Lent term) as well as one individual project in Easter term.

Setting up projects

The Michaelmas and Lent term projects are run in companies, each selected by a University Supervisor. The company and the University Supervisor agree a project brief for the student team, appoint a Company Supervisor with overall responsibility for the project, and a contact person for each team.

The Long Projects in Easter term are run by individual students. Based on the experience gained from the Michaelmas and Lent projects, students should develop and scope their own projects, which is an excellent opportunity to design a project that fits the individual student's preferences. MET teaching staff support students developing their projects (see further Long Project section below).

Project deliverables

MET projects are not artificial exercises: they are aimed at solving real, current problems in the company and the results are important to them. For each project the company managers and university supervisors expect two deliverables:

1. End of project presentations

This is particularly important to the company and is normally made to senior members of the operations and management team. The presentation typically takes place on the final afternoon or late morning of the project to an audience consisting of senior staff within the company. The University Supervisor also attends, as the presentation is an integral part of the student assessment. The presentation normally includes 30 minutes of presentation and 15-30 minutes of questions.

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 should be agreed with the University Supervisor, usually around 30min (not more than 45min if delivered in a more interactive way), and will be followed by questions. These will come from the company staff rather than the University Supervisor. Remember, the presentation is for the benefit of the company rather than for the supervisor. While the presentation is an opportunity for students to deliver their results to the company, students should also see the presentation as an opportunity to collect further feedback on their recommendations. High standards of organisation, structure, use of evidence, delivery and visual aids are expected.

2. Project reports

Following the presentation, every team needs to submit a joint project report. The report 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 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. Please keep in mind that the reports might be distributed across the company to people, who were not involved in the project.

Requirements for METIIB report style is given in Appendix 3 of this handbook. 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 max. 1 page giving an overview of the tasks for the whole project, the applied methods/ techniques and the key outcomes/ recommendations. If sub-teams are formed, the report should reveal which team has worked on which sub-project. 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.

Reports should be as long as needed to display sufficient detail for an informed reader, who knows the company, to understand what the project is about, what students have done and how this has led to the results and subsequent recommendations. The report should be kept to the minimum length focusing only on the relevant content. Additional, potentially interesting content (e.g. certain observations made during the project) can be submitted separately to the company supervisor or could be included in appendices to the report.

In addition to the above it might 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.

During the week following the project the University Supervisor holds a supervision with each team and gives detailed feedback on the performance. During the supervision students are asked for their perceptions of the company. Modifications to the report may be necessary following the supervision. A final version of the report must be submitted following the supervision, and will be checked by the supervisor before being sent off to the company.

Please read the following carefully.

- 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.

- 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.

Projects timetable

The projects are structured to expose students to problems of increasing complexity, and with increasingly unspecific objectives and methodological guidance. The time allocated to each project also increases as MET IIB 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:

Michaelmas Term (3 day – Induction project and 2-week project)	Groups of 4 (to 5) students	Investigating company problems principally of a technical nature typically related to certain manufacturing processes
Lent Term (4 (2+2) week project)	Groups of 4 (to 5) 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 projects within the IfM's definition of manufacturing

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 appendices).

Responsibilities

For the Michaelmas and Lent term projects, each team should appoint a **Team Leader** to be responsible for co-ordinating all arrangements, particularly the communication with the university and company supervisors.

A **University Supervisor** makes pre-project arrangements with the company; briefs students before the project; is generally available for contact during the project and attends the final presentation and provides feedback and guidance during supervisions.

A **Company Supervisor** is an employee from the company who has overall responsibility for the project.

Assessment

Assessment of the project work is based on the presentation and report with five assessment criteria. These include the effectiveness of 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 company.

All projects will be marked independently by the University Supervisor and another MET staff member, who then will agree on the marks. In other words, all project reports are graded twice – by the University Supervisor and by an Assessor. Please keep in mind that 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'. The induction part of the Michaelmas project will only be marked by the University Supervisor.

Appendix 2 of this handbook contains examples of the marking form to be used by the University Supervisors that shows the weighting given to each element of the assessment criteria. Students receive written feedback from their supervisor via CamCORS.

General 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. At this supervision there is a general review of the project experience and feedback from the supervisor on the project report and team performance.

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 submitted via Moodle by the due date. If a hand-over file is produced this must be submitted at the same time so that the supervisor has a full appreciation of what has been achieved.

iv. The MET Teaching Office staff will forward the files to the University supervisors and second markers for comment and marking.

v. The project supervision, and any amendments to the report must be completed before the final submission deadline. The original report, including supervisor's comments, and the amended report must be handed in by this deadline.

vi. The MET Teaching Office staff send the amended report and possibly 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 distribution within seven days. Details of all hand in dates are given in the section entitled "Industrial Project Report Hand-In Dates 2022-2023".**

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 part week, that the work is late

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

Attendance

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

Project supervisions

For all group projects in Michaelmas and Lent term 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. discussing progress with students during the project;

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.

Students are in charge of setting up their Easter term project and find a supervisor from the MET teaching staff.

Every project will need to have a Company Supervisor to look after the day-to-day running of the project in the company.

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 reports.

Confidentiality

Companies may require students to sign a confidentiality/ non-disclosure agreement (NDA's), usually prior to the start of the project. 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. Students are strongly advised to strictly adhere with the regulations set out in the agreement.

Michaelmas term: The Three-day (Induction) and Two-Week Project

During the Michaelmas term student will complete two projects. The first project is known as the induction project and will lasts three days. This project serves as an introduction to the industrial project's component of MET IIB. The second project lasts for two weeks and forms the core of the Michaelmas projects.

Project objective and aims

The overall objective of the Michaelmas projects is for students to investigate and help solving primarily technical/ industrial problems.

During the induction project the focus should be on investigating and systematically assessing (diagnosing) a problem, typically related to a certain (part of a) manufacturing process. The second project should be dedicated more to developing and recommending solutions to problems associated with certain manufacturing related processes.

The aims of the Michaelmas projects are to:

i. gain first hand insights to the key functions in a typical manufacturing company;

ii. enable you to make business relevant recommendations based on evidence gathering, analysis, interpretation and collation of data;

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. during the induction project, to provide a first non-assessed experience of MET IIB style project work.

Agreeing projects

For the 2-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. For the induction project students will be assigned to companies prior to the start of term.

Project reporting and assessment

Both at the end of the 3-day induction project as well as the second and main 2-week project, students will have to deliver an oral presentation to the company and a written report. In other words, for this Michaelmas projects, students will have to deliver two presentations and two reports, of which the first set serves a 'training' purpose.

For the Michaelmas projects, both parts are assessed. The induction project is assessed for teams using the assessment form shown in the appendix in the same way as the other projects forthcoming later in the METIIB programme, but the marks do not count towards the final degree: the feedback is intended to ensure students are calibrated for subsequent projects. The second main project (the 2-week project) is assessed in a similar way. However, the marks for the second project count towards the final degree.

Project and assessment timetable

	Timetable for 3-day project	**Timetable for 2-week project**
Duration:	5 October to 7 October	24 October to 1 November
Company presentation:	Afternoon (possibly late morning) 7 October	Afternoon (possibly late morning) 4 November
Draft Copies - Moodle electronic submission	By 8:45 hr. BST Monday 10 October	By 8:45 hr. GMT Monday 7 November
Supervision with University Supervisor:	By end of Friday 14 October	By end of Friday 11 November
Final Copies - Moodle electronic submission	By 8:45 hr. GMT Wednesday 19 October	By 8:45 hr. GMT Wednesday 16 November
Reports sent to companies:	By Friday 21 October	By Friday 18 November

IMPORTANT NOTE: The assessment is made on the first report version, <u>not</u> the revised (final) version.

Project implementation

The students in the team allocated to a company assume joint responsibility for the project. They work in teams of 4-5, possibly split up into specific sub-projects, e.g. related to different parts of the company or a specific manufacturing process; taken together these sub-projects are likely to cover a substantial part of the main areas of the company.

Lent term: The Four-Week Project

The four-week project is split into two parts of two weeks each and a break of two weeks in between. Students are encouraged to think about how to best use the break. In the past, we have seen examples of students delivering a first version of a prototype at the end of the first part. The company's engineers were then asked to test and trial it during the break and complete a questionnaire. When students returned for the second part they started with analysing the feedback provided via the questionnaire as input to then develop a second version of the prototype. Other students have used the break, for instance, for the company ordered material so students could build a workstation prototype in the second part.

Agreeing projects

For the 4-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 objective

The overall objective of the 4-week project is for students to help solving an industrial problem that has some technical, but also some business-related components. Projects are typically designed so that students are asked to conduct an in-depth problem analyses in the first part, then develop solutions and propose recommendations in the second part. Often 4-week projects involve some actual design / development of an artefact (e.g. work station), occasionally even a software tool.

Project reporting and assessment

Students have to deliver a presentation to the company at the end of the second part, followed by a detailed project report. Both the presentation and the report are part of the assessment using the five assessment criteria as explained above. Please see the appendix for the assessment form.

Project and assessment timetable

	Timetable for 4-week project
Duration:	Part 1: 30 January – 10 February Part 2: 27 February – 10 March
Company presentation:	Afternoon (possibly late morning) on 10 March
Draft Copies - Moodle electronic submission.	Before 8:45 hr. GMT Monday 13 March
Supervision with academic supervisor:	By end of Friday 17 March
Final Copies - Moodle electronic submission.	By 8:45 hr. GMT Wednesday 22 March
Reports sent to companies:	By Friday 24 March

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

Project implementation

The student group allocated to a company assume joint responsibility for the project. They work in teams of 4-5, possibly split up into specific sub-projects related to different parts of the company; taken together these sub-projects are likely to cover a substantial part of the main areas of the company.

Due to the Covid-19 situation it remains uncertain to what extent Lent term projects will be able to run on site. While we hope this will largely be possible, students might need to be prepared to operating projects at least partly remotely.

Travel arrangements

We strongly encourage travel for students to be on-site as this contributes to the project and learning experience. Given current remaining Covid-19 uncertainties about the situation in the winter months further details about travel arrangements will have to be communicated later.

Easter term: 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 timetabled towards the end of Lent term. **In contrast to the other projects, which are organized by University Supervisors, students themselves are responsible for developing, planning and organizing their Long Project.**

Long Project requirements

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

i. projects must include a substantial 'manufacturing' content. In this context manufacturing is taken to mean the very wide definition adopted by the IfM and used as a basis for MET teaching;

ii. projects must be completed by individuals and not by groups as with earlier projects;

iii. the project must be a clearly defined piece of work, usually aimed at solving a specific problem. Projects often arise from previous work done by a company but the starting point and boundaries of the student's work must be clear. It must be possible to demonstrate exactly what the student has contributed;

iv. projects must be agreed in consultation with the University Supervisor and the company contact;

v. projects typically consist of a detailed scoping study undertaken in the preparation week towards the end of the Lent term, a data gathering and analysis phase, some degree of solution generation, results leading to implementation or trialled implementation;

vi. the scoping study must be agreed with the Company and University Supervisor and will include:

- assessment of the subject area to determine key issues requiring investigation;
- preparation of a project brief including background, objective and approach to be taken;
- preparation of a project time line (GANTT chart).

Agreeing Long Project topics

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

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

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

Students have to indicate on their Long Project Preference Questionnaire if they plan to pursue an own (i.e. self-developed) project or pick-up a topic provided by a supervisor. All projects need to be agreed with the MET IIB Director and Projects Coordinator by the 20st January 2023. Subsequently, all proposals will be reviewed by an internal committee, which will approve projects or come back to students asking for adjustments.

After projects are approved students should ensure to start making arrangements for the preparation week. Students should contact their company to agree the time they will be spending on the company site during the preparation week as well as the university supervisor early to arrange a meeting early in the preparation week. Given the current Covid-19 uncertainties students will receive further details later, but as soon as possible.

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'.

IMPORTANT NOTE: The assessment is made on the first report version, <u>not</u> the revised (final) version.

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

17 October 2022	Students introduced to the Long Project Timetable. Students briefed on scope and requirements for projects. Students begin search for potential project topics. Students start meeting potential long project supervisors.
14 November 2022	Students return questionnaires to IfM Teaching Office outlining their interests and ambitious for the long project. Preliminary allocation of supervisors by project coordinator.
12 December 2022	Students to return protocol form summarizing the meeting with the supervisor. The form needs to be signed by the supervisor.
20 January 2023	Submission of project proposal form and cut-off date for student self-selection of projects. Students without a suitable project can subsequently be assigned a project.
13 March 2023	Start of preparation week. By the end of the week students should have agreed a detailed project brief incl. Gantt chart type of project visualization with university and company supervisors.
17 March 2023	Electronic submission of project brief to Teaching Office and project Supervisor.
1 May 2023	Projects start
9 June 2023	Last day for project presentations.
12 June 2023	Long Project report submission in electronic form to Teaching Office and Supervisor.

Travel arrangements

We strongly encourage travel for students to be on-site as this contributes to the project and learning experience. Given current Covid-19 uncertainties further details about possible travel arrangements will have to be communicated later. Companies will have to cover travel costs.

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 project visits 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 student 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.

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 Industrial Projects Organiser, respectively the MET IIB Course Director.

Expenses and travel

Claiming of expenses

For the Michaelmas and Lent term projects, travel and other expenses can be covered by the MET teaching office. For the Long project in Easter term, all expenses should be covered by the host organisations. In cases where this is not possible, and if this has been agreed with the University Supervisor and MET Senior Administrator in advance, claims can be submitted to the IfM Teaching Office but the following very important points should be noted:

1. All claims must be supported by receipts.

2. Any claim submitted more than six weeks after the expense has been incurred will not be refunded.

3. Students must not enter into any financial arrangements without checking with the IfM Teaching Office. There are set procedures required by the University that cannot be breached.

Travel arrangements

Introduction

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

Accredited drivers

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

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

Responsibilities of drivers

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

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

In addition, drivers have the following operational responsibilities to:

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

Repair and Maintenance

i. Routine maintenance and servicing is organised by the IFM Teaching Office.

ii. Emergency work necessary while the vehicle is away from Cambridge must be authorised by the IfM Teaching Office. Arrangements will normally be made for invoices to be sent to the university.

iii. Reimbursement of the cost of essential small purchases for maintenance should be claimed on an expenses claim form. Receipts must be submitted to support all claims.

Accidents and Breakdown Emergencies

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

Alternative Transport

i. If, by prior agreement with the IfM Teaching Office only, public transport is used as an alternative to the normal fleet of vehicles the costs agreed in advance will be reimbursed. The costs will normally include bus, coach or student rail fare.

ii. Taxi's cannot be refunded without prior agreement with the IFM Teaching Office.

iii. Expenses will not normally be paid for travel within Cambridge i.e. within a 3 mile radius of Great St Mary's Church.

iv. Use of rental cars may sometimes be necessary when the IfM cars and minibuses are unavailable. The IfM Teaching Office will organise this with a local firm, but it will be the responsibility of the named designated driver to collect and return the vehicle as required under the agreement made with the car hire firm. In this case, you will have to pay for any fuel and claim payment back from the IfM Teaching Office as fuel cards will not be valid for a hire car.

Contacts

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

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

Appendix 1: Penalties for lateness, and statement on plagiarism
Penalties

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

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

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

Rearranging coursework submission or missing the Robot Lab or Projects

Reasons fall into one of the following four categories:

1. **Illness**

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

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

2. **Compassionate or religious grounds**

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

3. **Interviews**

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

4. **Sporting commitments**

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

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.

Plagiarism and good academic practice: your responsibilities

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.

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

Appendix 2: Sample MET IIB Forms

Industrial Project Michaelmas project – University Supervisor Project Assessment
Industrial Project Lent project – University Supervisor Project Assessment
Industrial Project Easter project – University Supervisor Project Assessment
Industrial Project – Company Supervisor feedback form
Health and Safety on Industrial Projects
Allowance form for missing days of Industrial Project / Robot Lab

Michaelmas term: 2 Week Project – University Supervisor Project Assessment

MANUFACTURING ENGINEERING TRIPOS

Confidential METIIB Industrial Project Assessment (2Week)

Student:	
Company:	
Assessed By:	
Date:	

	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"?*			
Justification for mark:			
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?*			
Justification for mark:			
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?*			
Justification for mark:			
D. Structure and Style of Interim 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?*			
Justification for mark:			
E. Interim 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?*			
Justification for mark:			

	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.)*	**0.00**	**0.00**

Note: supervisors should not give any indicative marks / grades to the students

Lent term: 4 Week – University Supervisor Project Assessment

MANUFACTURING ENGINEERING TRIPOS

Confidential METIIB Industrial Project Assessment (4 Week)

Student:	
Company:	
Assessed By:	
Date:	

	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"?*			
Justification for mark:			
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?*			
Justification for mark:			
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?*			
Justification for mark:			
D. Structure and Style of Interim 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?*			
Justification for mark:			
E. Interim 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?*			
Justification for mark:			

	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.)*	**0.00**	**0.00**

Note: supervisors should not give any indicative marks / grades to the students

Easter term: Long Project – University Supervisor Project Assessment

MANUFACTURING ENGINEERING TRIPOS

Confidential MET IIB Industrial Project Assessment (Long)

Student:	
Company:	
Assessed By:	
Date:	

	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"?* **Justification for mark:**			
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?* **Justification for mark:**			
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?* **Justification for mark:**			
D. Structure and Style of Final 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?* **Justification for mark:**			
E. Final 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?* **Justification for mark:**			

	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.)*	**0.00**	**0.00**

Note: supervisors should not give any indicative marks / grades to the students

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

Health and Safety on Industrial Projects

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

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

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

Student Name:	**College:**	**CRSID:**

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

Tutor's name:	e-mail:	Phone:

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

Nature of illness or extenuating circumstances:			
Dates between which work was **impossible**		Dates between which work was **hindered**:	
Additional comments (attach separate letter if you wish) *Please enclose doctor's certificate if period affected was more than 7 days*			
Signature of Tutor	Date	Signed (MET Course Administrator / METIIB Director / Project Coordinator / Robot Lab Coordinator)	Date

***Return completed form to**: IfM Teaching Office, IfM, 17 Charles Babbage Road met-admin@eng.cam.ac.uk*
Decisions will be made by the METIIB Course Director, in conjunction with MET Course Administrator/Robot Lab Coordinator / Project Coordinator.

Appendix 3: MET Report Template and Style Guide

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

UNIVERSITY OF CAMBRIDGE

Institute for Manufacturing

Report Title in this box

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

Company Name

Supervisor: Supervisor's name

Author Name

Date

Executive Summary

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

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

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

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

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

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

Author name

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 12pt, 0pt before, 6pt after)

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

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

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

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

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

1.2 Each section should be initialed

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

2.0 Guidance on formatting

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

Typical content would include:

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

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

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

2.1 Subsection

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

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

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

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

2.2 Tables, Figures etc.

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

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

Reason	% of total
Slept in	48.5
Hung over	48.5
Moral objection	1.0
Mislaid bicycle/puncture	1.0

Really good reason	1.0

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

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

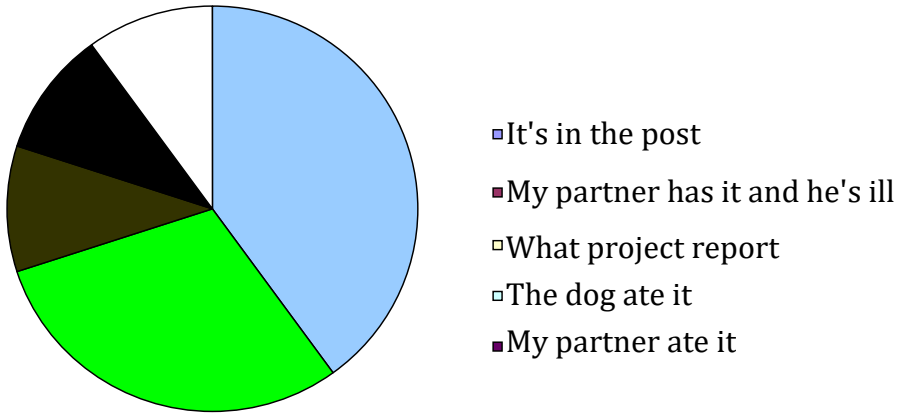

Figure1: Reasons given for late hand-in of project reports. Origin: MET Office (2005).

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:

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

Naming a DRAFT report:

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

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

Naming a FINAL report:

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

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

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

5.0 Conclusion

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

Appendix 4: The Overseas Research Project (ORP)

Please note: Due to the emerging Covid-19 situation is remains unclear at this point of whether an ORP can run this year.

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

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

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

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

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

VERY IMPORTANT

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

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

Key actions and timings

When	What
By the end of MET IIA	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 Administrator, Mukesh Kumar and IfM-ENGAGE 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-ENGAGE 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-ENGAGE 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)