



# Examiners Report

## Autumn 2022

### Exam to Assess Master Level Learning

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## Background

This report is compiled by the ICE Further Learning Examinations Panel. The Examination tests whether BEng graduates (including Hong Kong graduates impacted by Washington Accord changes) have gained through further learning an academic standard of learning and critical thinking equivalent to MEng candidates.

The ICE is required by the Engineering Council to assess academic standards achieved in candidate's technical knowledge alongside management, contractual and other syllabus areas covered by the Case-Study Exam. Candidates are required to submit a Part A Technical Statement in advance of the Part B Case-Study Exam. Parts A and B are marked by the same two Script Markers.

The ICE is indebted to those chartered members who volunteered to mark submitted scripts, and to members of the Further Learning Examination Panel who developed the syllabus and learning materials, set the examination, moderated the marking and considered appeals.

## Hong Kong Examination 2022

84 candidates sat the exam, 82 from Hong Kong, one from Oman and one from Australia. A number were resits having failed either Part A or Part B at previous exams.

As some resit candidates only sat the Part B exam, having previously had a Part A Further Learning Technical Report approved, it is prudent to breakdown the analysis of pass rates.

|  | Total Marked | Pass | Fail | % Pass |
|--|--------------|------|------|--------|
| Part A Further Learning Technical Report | 81           | 54   | 27   | 67%    |
| Part B Case Study Examination            | 83           | 45   | 38   | 54%    |

It is noticeable that 82% of candidates who passed Part B also passed Part A – they seemed well prepared for both parts. Conversely, Script Markers noted that candidates who failed Part A struggled in the Part B exam. This suggests that some candidates are taking the exam too early, i.e. before they have undertaken sufficient further learning. Importantly, 65% of candidates who had registered to study the Online Training Modules passed the Part B Exam. A lack of knowledge of important elements of the syllabus was evident in many of the failed papers.

Two candidates who failed the Part B Exam were found to have pasted into their responses text from sources that were not clearly referenced. This was not judged to be plagiarism but is a cause of concern. The Guidance Document sent to all candidates makes clear that plagiarism is presenting the work of others as your own and should be avoided. Candidates should not cut and paste material from others. Where they directly quote the work of others, they should attribute the source fully and, where appropriate, use quotation marks. ICE checks exam scripts using software that detects plagiarism, and Script Markers are trained to beware of unattributed quotations.

Each paper is marked by two trained Script Markers. In cases where Markers disagree on pass/fail marks an independent Moderation Panel reviews marking before awarding a pass or fail mark.

An External Examiner advises the Further Learning Examinations Panel on the standard of the exam and the questions set, and audits consistency of marking. The External Examiner reviewed the decisions of the Moderation Panel and agreed with the decisions reached. Nine further papers were reviewed where the two Markers agreed pass/fail decisions including marginal cases. The External Examiner found that in each case where Markers agreed pass/fail grades the decision was valid.

## Reflection

This was the first sitting of the ICE Further Learning Examination. Much has been learnt from the three pilot exams previously held. The improved guidance issued for the Part A Further Learning Technical Submission led to a higher standard of submission than in the last pilot. Candidate briefings led to candidates structuring their Part B answers better, applying knowledge to the scenario, demonstrating knowledge across the syllabus and planning their responses to avoid running out of time.

The External Examiner, and the Further Learning Examination Panel, consider the main learning point is that candidates who failed were on the whole unprepared or insufficiently experienced.

ICE members wishing to take the Chartered Professional Review, and who do not yet hold an approved Masters level academic qualification, can bridge the gap between their bachelors level qualification and the required standard by:

1. Undertaking a MEng Course (normally one year) and passing associated examinations;
2. Learning through work experience over at least five years and undertaking an Experiential Learning Assessment; or
3. Supplementing learning gained through work experience with a course of study before sitting the ICE Further Learning Examination.

It was evident from some Part A Technical Submissions that candidates had not yet gained sufficient experience to demonstrate masters level academic learning in technical areas. Part B candidates failed because they had not learnt sufficiently across the syllabus. The gap between bachelor level qualifications and the master level standard cannot be bridged without further learning. Experiential learning requires exposure to different roles and contracts. CPD and structured learning will accelerate and enhance knowledge gained through experience.

Future candidates who wish to sit the Further Learning Exam earlier than might be the case for the Experiential Learning Route, should consider studying the Online Training Modules developed specifically for the exam, and/or studying the ICE Companion to Engineering Management, which has been compiled specifically to help candidates prepare for the exam.

Candidates who fail the exam will be disappointed and may wish to re-sit at the earliest opportunity. The exam is, however, a test of whether candidates are able to demonstrate and apply an MEng level of learning gained through further study and practice. Candidates should consider whether they need to undertake further study in some syllabus areas before resitting the exam.

## Rationale behind Part A and Part B

The Engineering Council defines Learning Outcomes to be achieved through academic study. The Exam assesses whether Master level learning outcomes have been achieved.

The **Part A Further Learning Technical Report** requires candidates to demonstrate how they have continued to learn post qualification to achieve Masters level technical learning outcomes. The submission comprises: *“A 500-word Technical Statement and supporting Appendix based on one or more appropriate project(s) or activities that demonstrate Masters level technical knowledge in a civil engineering context. It should demonstrate a candidates ability to integrate prior knowledge and understanding of the discipline and engineering practice with the development of advanced level knowledge and understanding, to solve a substantial range of engineering problems, some of them complex or non-routine.”*

The Further Learning Technical Statement is not simply a report describing a candidates work on recent projects. The purpose is to demonstrate academic learning gained since graduating, and to evidence how a candidate has applied knowledge in an innovative way to overcome a particular challenge. It is a test of academic learning alongside practical experience.

A good statement may describe a computational technique (calculations or modelling) that the candidate has applied or adapted to solve a particular problem. It is important to describe the candidate's contribution to the work of a team. For example:

An engineer supervising piling operations may explain how unexpected ground conditions and underground structures at one corner of the site caused them to question the validity of the piling design. Drawing on previous structural design experience and CPD courses undertaken on finite element software, they were able to use this software to consider alternative solutions. Calculations and software outputs might be appended.

A drainage engineer might explain how a lack of flooding during an intense rainfall event had caused them to question the validity of modelling outputs. By commissioning CCTV surveys and observing overland flows during heavy rain they were able to recalibrate the model by applying further CPD learning gained on Micro-Drainage software courses, and by learning from experienced colleagues. Modelling outputs could be appended.

It is important that candidates understand the purpose of the **Part B Case-Study Exam**, which is to demonstrate that Masters level learning outcomes have been achieved across the syllabus. Whilst ICE has provided online further learning modules and the ICE Companion to Engineering Management, the examination is not a test of that knowledge alone. Candidates will be expected to draw on experiential learning developed over their career, knowledge gained through CPD, and to apply that learning through critical thinking in relation to a specific scenario.

The exam syllabus aligns closely with the attributes required for the Chartered Professional Review:

- Procurement, Contracts & Project Management
- Project Appraisal & Financial Management
- Sustainable Development
- Management & Leadership
- Health, Safety, Welfare & Risk Assessment

Candidates are required to apply their learning to an unfamiliar case-study. At the start of the examination candidates should read the scenario and each of the questions carefully. The questions are often connected and together afford the candidate with opportunity to demonstrate a broad knowledge. They should plan how to answer each question whilst covering the syllabus breadth. Writing three paragraphs of learned knowledge is unlikely to gain marks unless it applies directly to the question and scenario.

Providing candidates with a full day for the examination provides time to plan, to consider case-study implications, and to demonstrate syllabus knowledge, learning and critical thinking.

## Moderation Panel Report: Part A Further Learning Technical Report

Successful Part A candidates were able to demonstrate application of advanced further learning in a work environment. A number of candidates structured their statements in accordance with ICE Further Learning Exam Guidance so that the nature of the project they were working on and their role within the team were clear; the manner in which they had gained advanced knowledge was explained; and the application of that knowledge to overcome a specific challenge was clearly evident. Appendices were used to support their statement. In some cases research undertaken was described and the pros and cons of alternative solutions compared.

Those candidates who failed, tended to provide a commentary of their work rather than explaining how they had applied a higher level of knowledge gained through further learning. One submission used excellent graphics to illustrate a project but failed to explain any application of engineering principals. Another mentioned "We were commissioned to conduct detailed design..." without explaining the candidate's role in the design or presenting any calculations or analysis. A further candidate mentioned consideration of different failure modes and finite element modelling, without then providing any modelling outputs or calculations.

## Moderation Panel Report: Part B Wamala Case Study Exam

Candidates have on the whole learnt from Examiners Reports from pilot exams and taken note of the candidate briefings we have provided. Responses were structured better.

The first rule should be to read the paper fully, ensuring that the scenario and each part of a question is understood. Time spent reading the case study, deconstructing the questions (understand each part) and planning the essays is time well spent.

Examples of strong and not so strong responses to questions posed in the Wamala case-study are outlined below:

**Question 1: What are the risks and opportunities of this development that can be addressed in the short, medium and longer term by adopting an appropriate procurement strategy, what might this strategy be and how should it be implemented and managed?**

The question focuses on an appropriate procurement strategy which aligns with Module 1 of the syllabus: procurement, contracts and project management. There was also scope, however, to discuss elements of Module 2, Module 3 and Module 5.

A tabulation of short, medium and longer-term risks/opportunities would set the context for the procurement strategy and ensure a focus on IDS/WDS objectives. By reading through the scenario and questions, candidates would know that current open drainage systems pose a health risk (Q3) and a failure to evidence progress against objectives may prejudice longer term funding. A programme of procuring design and construction contracts to address short term priorities and strategic goals would lead to a strategy that evolves from commissioning of international contractors to the development of a local supply chain. Discussion of forms of contract might differentiate between different phases of the programme. Implementation and management might include leadership goals, risk management to maintain focus on the risks/opportunities identified and performance management to ensure successful delivery against IDS/WDS objectives.

Some risks were evident in the case study, but good candidates looked beyond this to consider risks such as inflation and legislative change affecting long term projects, changing social risks as investment improved wealth within the community, and the need to procure drainage and sanitation works early to address health risk. Stronger responses differentiated between early-stage procurement (FIDIC Orange Book contract) and the opportunity to encourage collaboration (NEC) as local supply chains matured. SMART KPIs were discussed in the better responses for reporting purposes and to continually improve performance. References to appropriate authors were quoted.

Weaker responses failed to consider risks and opportunities sufficiently, were lacking in critical thinking, demonstrated little knowledge of procurement and failed to employ management and leadership techniques for the implementation/management element of the question.

### **Question 2: How might sustainability be achieved, including managing conflicting ethical issues?**

The first element of the question focuses on Sustainable Development (Module 5) whereas the management of ethical issues required reference to the nature of professionalism, and morality, integrity and responsibility which are covered in Module 2.

Critical discussion of UNSDGs should consider why each is relevant and how they might be addressed at Wamala. Managing conflicting ethical issues provides opportunity to use stakeholder engagement to understand social issues and to involve local communities. Whilst good responses recognised the risk of corruption, few covered the five strands of legislation (eg US Foreign Corrupt Practices Act), contract (eg NEC4 Clause 91.8), embedding an anti-corruption culture within the team, fair payment policies and personal responsibility as per ICE code of conduct. Importantly, the question asks about managing conflicting ethical issues which requires an understanding of social and economic impacts of deprivation, and how increased wealth in one part of a community can increase crime and corruption elsewhere.

Good responses focussed on 5 or 6 UNSDGs and critically discussed how they may influence design, management and construction at Wamala. Brundtland was referenced in discussing the four pillars of sustainability. Sustainability KPIs such as CO2 footprint and number of trainees were mentioned as performance management tools. Better responses also used triple bottom line accounting to ensure a continuous focus on sustainability. One response linked training and education within the workforce (Goal 4) to driving an anti-corruption culture and referenced the ICE Code of Conduct.

Weaker responses made reference to UNSDGs but failed to demonstrate significant depth of knowledge or to adequately discuss them in relation to the scenario. It is difficult to evidence critical thinking if a candidate attempts to mention all 17 UNSDGs – there isn't sufficient time. Some responses were too brief to enable critical discussion. Few responses discussed conflicting ethical issues, and a number failed to cover ethical issues at all.

### **Question 3: During improvements to the drainage network a water borne disease breaks out. As project manager, outline the short and long-term actions you would put in place?**

The primary focus is one of Health, Safety, Welfare and Risk Assessment (Module 4). Placing the candidate in the role of project manager also requires an understanding of wider project impacts and associated management and leadership (Modules 1 & 2).

A water borne disease outbreak is as much a health and safety incident as a fall from height or a machinery related injury. The management of the incident should therefore follow good health, safety and welfare practice. Immediate actions should be to halt work on related activities, to inform relevant authorities and commence investigations. There is opportunity to apply qualitative/quantitative analysis techniques and apply ERIC principles to eliminate/reduce/isolate or control risk. Method statements and safe systems of works should be introduced or amended. The project manager should delegate responsibility to manage an effective response and should also consider wider resource and programming implications. Longer term actions may be to engage with the client to give greater priority to sanitation, to give a higher priority to health and welfare and to develop a post incident action plan to get the programme and budget back on track.

Good responses recognised the outbreak as a health and safety incident and tackled it in the context of the Health and Safety Plan and Risk Register. Works were suspended and investigations commenced using tools such as event tree analysis. A communication plan was developed to alert local communities. Longer term actions included a design review to eliminate risk (eg by covering open water courses using precast covered drainage channels) and cultural change instigated through effective leadership within the organisation to focus on zero harm.

Poor responses failed to recognise the outbreak as a health and safety issue, or to apply any associated management techniques, or to suggest any engineering solutions. One candidate wrote a number of paragraphs on the medical control of cholera, presumably found on the internet, and pasted in a procedure for managing covid, without explaining the relevance of either.

**Question 4: The construction of an early spine road requires materials not available locally. How would you manage reliable delivery? What are the leadership issues to be addressed in the longer-term supply chain programme?**

The first element of the question is one of managing reliable delivery which provides scope to demonstrate learning in project management (Module 1), whilst the second part refers specifically to leadership which falls within Module 2.

A good starting point for managing reliable delivery is to procure contractors and suppliers with proven track records. ISO9001 Quality Management Systems can provide a framework for consistent delivery. Project planning should pay heed to seasons when unpaved roads become impassable, and construction of spine roads might be prioritised to provide access to the rest of the site. BIM can facilitate scheduling/pricing alongside design. Conditions of contract and supply agreements can incentivise time/cost performance. In terms of leadership, a One-Team collaborative culture that extends across the supply chain can bring a whole team focus to reliable delivery. Ethics can be placed at the core of organisational behaviours, a shared vision and clear objectives can be linked to performance measures to drive continuous improvement. KPIs can be embedded within supply chain contracts.

Good responses recognised risks around long supply routes and suggested experienced contractors and ISO9001 as mitigating control measures. One candidate discussed BIM 7D and a common data environment (CDE) providing a framework for collaboration across geographies. Real time feedback to designers and suppliers could also help address delivery issues by amending designs and sourcing alternative materials. Leadership issues identified included a shared vision and common objectives to bring a whole team focus to successful delivery. Common values and behavioural leadership around trust and respect were identified as necessary across the wider organisation. Other candidates identified openness, transparency, inclusiveness and diversity as values a good leader should encourage.

Weaker responses failed to answer the question fully. Sub-headings help the candidate make sure they are answering all elements of a question and signpost their answers to the markers. The natural tendency to answer questions 1 to 5 in order means that time may be running out when Q4 is attempted. Better planning and time management might avoid this. Some responses were only half a page long which doesn't give much space for critical discussion. The first part of the question tended to be answered better than the second. Some candidates may not have experience of leadership: studying the management and leadership module of the syllabus more fully would help candidates answer this type of question better.

**Question 5: By Year 5 of the project, delays and cost escalations threaten the implementation programme. Evidence of social, economic, and environmental benefit is scarce. You are appointed to develop and present a comprehensive plan to Nansana Municipal Council and the Government. How would you assure them that delivery transformation over the next 15 years will achieve IDS/WDS strategic objectives?**

The primary focus of the question on cost escalation and a recovery plan aligns with cost and performance management which requires an understanding of Module 3 of the syllabus. There is scope, however, to discuss triple bottom line reporting (Module 5) and the motivation and leadership of project teams (Module 2).

In order to develop a comprehensive plan, a first step is to critically analyse performance to date and meet with the client and key stakeholders to understand expectations moving forward. Financial appraisal, cost benefit analysis, triple bottom line reporting and risk management are techniques to be considered. Value management workshops will identify areas for savings in both cost and time. The resulting Delivery Transformation Plan should demonstrate a clear understanding of where we are now and present a robust plan for getting back on track. Regular reporting of key performance indicators will provide confidence to the client that the Plan will be delivered effectively. A change management programme will be necessary within the organisation to transform delivery.

Better responses discussed techniques such as Earned Value Analysis to calculate cost and time variance and forecast outturn. Critical path analysis was discussed as a means of accelerating delivery. One candidate set out a detailed 9 step approach to cost benefit analysis culminating in a report to the client, followed by a 5 stage approach to value engineering. Another candidate critically discussed lean construction as a means to increase efficiency and effectiveness. The potential of BIM to plan ahead in terms of design, scheduling and to appraise cost reduction was similarly explored.

Some responses were very short as candidates ran out of time. Weaker responses were superficial with little analysis of current performance and no mention of the recovery report expected by the question (performance targets, monitoring & reporting). Few candidates explored why performance to date had failed, and why a change management programme may be necessary to improve personal and organisational performance, or to transform organisational culture.

