Highfield Level 4 End-Point Assessment for ST0192 Improvement Practitioner

End-Point Assessment Kit

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EPA Kit

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Versions:

ST0192 / v1.2

IMP v3.0

How to use this EPA Kit

Welcome to the Highfield End-Point Assessment Kit for the Level 4 Improvement Practitioner apprenticeship standard.

Highfield is an independent end-point assessment organisation that has been approved to offer and carry out the independent end-point assessments for the Level 4 Improvement Practitioner apprenticeship standard. Highfield internally quality assures all end-point assessments in accordance with its IQA process, and additionally, all end-point assessments are externally quality assured by the relevant EQA organisation.

The EPA Kit is designed to outline all you need to know about the end-point assessments for this standard and will also provide an overview of the on-programme delivery requirements. In addition**,** advice and guidance for trainers on how to prepare apprentices for the end-point assessment is included. The approaches suggested are not the only way in which an apprentice may be prepared for their assessments, but trainers may find them helpful as a starting point.

In this kit, you will find:

- an overview of the standard and any on-programme requirements
- a section focused on delivery, where the standard and assessment criteria are presented in a suggested format that is suitable for delivery
- guidance on how to prepare the apprentice for gateway
- detailed information on which part of the standard is assessed by which assessment method
- suggestions on how to prepare the apprentice for each part of the end-point assessment
- a section focused on the end-point assessment method where the assessment criteria are presented in a format suitable for carrying out 'mock' assessments

Introduction

Standard overview

Improvement practitioners use a blend of Lean and Six Sigma, project and change management principles and tools to identify and lead the delivery of change across organisational functions and processes. Improvement practitioners can be found across all sectors and functions including automotive, banking, engineering, food products, IT, property, retail, telecoms, etc.

Typically, practitioners lead smaller projects and/or play a key supporting role in a larger programme. They tackle issues that may require swift problem-solving or recurring challenges that require in-depth analysis and the implementation of a range of effective and sustainable countermeasures. They are the focal point for all stakeholders and responsible for communication throughout a project. Typical activities include:

- identifying potential opportunities, diagnosing issues, proposing solutions and implementing changes and controls
- coaching teams and sharing best practice
- leading projects and managing small teams, ensuring motivation and momentum, and being responsible for the successful completion of the projects

There are a variety of job titles associated with the occupation, these include, but are not limited to: business improvement practitioner, continuous improvement manager, process excellence manager, Lean Six Sigma Green Belt and quality control senior analyst.

On-programme requirements

Although learning, development and on-programme assessment is flexible, and the process is not prescribed, the following is the recommended baseline expectation for an apprentice to achieve full competence in line with the Improvement Technician apprenticeship standard.

The on-programme assessment approach will be agreed between the training provider and employer. The assessment will give an ongoing indication of an apprentice's performance against the final outcomes defined in the standard. The training provider will need to prepare the apprentice for the end-point assessment, including preparation for the professional discussion and collation of the log of evidence (such as a provision of recordings of professional discussions or workplace evidence).

The training programme leading to end-point assessment should cover the breadth and depth of the standard using suggested on-programme assessment methods that integrate the knowledge, skills and behaviour components, and which ensure that the apprentice is sufficiently prepared to undertake the end-point assessment. Training, development and ongoing review activities should include:

- the achievement of level 2 English and maths. If the apprentice began their apprenticeship training before their 19th birthday, they will still be subject to the mandatory requirement to study towards and achieve English and maths. The requirements for English and maths are optional for apprentices aged 19+ at the start of their apprenticeship training.
- completion of a log to be used to underpin the professional discussion
- completion of a project portfolio to evidence completion of an improvement project(s)

Log

The apprentice must complete a log that will be used to underpin the EPA professional discussion. The log will typically include **1** piece of evidence for each knowledge, skill and behaviour (KSB) that is assessed in the professional discussion.

The log will typically reference between **13 and 15** pieces of evidence and must be holistically mapped against the KSBs. For example, the apprentice may write up a meeting held with stakeholders to demonstrate team working and communication or provide application of learning to the wider job role.

The log **must** be accompanied by a log evidence matrix. This can be downloaded from our website. The log matrix **must** be fully completed, including a declaration by the employer and the apprentice to confirm that the log is valid and attributable to the apprentice.

The log of evidence **must** be submitted to Highfield at gateway. It is **not** directly assessed but underpins the professional discussion.

Project portfolio

The apprentice **must** complete a project portfolio to evidence completion of an improvement project(s). The improvement project(s) will be the subject of a project report to be produced during the end-point assessment period and the subject of the presentation and questioning component.

The improvement project **must**:

- clearly demonstrate delivery of a business improvement benefit(s) as confirmed in writing by the apprentice's employer
- be completed in the apprentice's workplace
- address substantive business problem(s)
- follow each step of 1 of the recognised improvement methodologies

Use of artificial intelligence (AI) in the EPA

Where AI has been used as part of the apprentice's day-to-day work and forms part of a project report, presentation, or artefact, it should be referenced as such within the work. AI must not be used to produce the report or portfolio.

Where AI has been used as part of a portfolio that underpins an interview or professional discussion or any other assessment method, it should be fully referenced within the portfolio.

Additional, relevant on-programme qualification

There are no mandatory qualifications for this standard, however, employers may wish to include relevant qualifications to help structure the on-programme delivery.

Readiness for end-point assessment

For an apprentice to be ready for the end-point assessments:

- the employer must be satisfied that the apprentice is consistently working at or above the level set out in the standard. To ensure this, the apprentice must attend a formal meeting with their employer to complete the Gateway Readiness Report.
- the apprentice must have completed the **log of all training**, learning and workshops they have attended. The log will typically include 1 piece of evidence for each to cover each one of the required standards.
- the apprentice must have completed a **project portfolio** to evidence completion of an improvement project(s).
- the apprentice must have achieved level 2 English and maths. The requirements for English and maths are mandatory for all apprentices aged between 16-18 at the start of their apprenticeship training. The requirements for English and maths are optional for apprentices aged 19+ at the start of their apprenticeship training.
- the above must be completed, the apprentice and the employer should then engage with Highfield to agree a plan and schedule for each assessment activity to ensure all components can be completed within a 2-month end-point assessment window. Further information about the gateway process is covered later in this kit.

If you have any queries regarding the gateway requirements, please contact your EPA Customer Engagement Manager at Highfield Assessment.

Order of end-point assessments

Both the presentation and questioning around the project report and the professional discussion underpinned by log will take place on the same day during month **two** of the end-point assessment window, with a minimum of 2 weeks' notice period given to the employer.

The multiple-choice examination can take place at any point during the end-point assessment window.

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The Highfield approach

This section describes the approach Highfield has adopted in the development of this end-point assessment, in terms of its interpretation of the requirements of the end-point assessment plan and other relevant documents.

Documents used in developing this end-point assessment

IMP (2023)
Improvement Practitioner / Skills England

End-point assessment plan (ST0192/v1.2)
https://skillsengland.education.gov.uk/media/vvxf5sri/st0192_improvement-practitioner_l4.pdf

Specific considerations

In accordance with the Improvement Practitioner assessment plan, Highfield has noted that where assessment criteria are not present these have had to be created based on the standard. The assessment criteria have been written based on the standard and the grading criteria taken from the assessment plan.

For the presentation and questioning and professional discussion, Highfield has taken the decision to allow apprentices the maximum allocated time as stated in the assessment plan.

For the multiple-choice exam, the assessment plan states that 40 questions should be drawn at random for every test. Highfield has created a bank of questions for the Improvement Practitioner EPA and questions are drawn from this bank to create examination papers, which ensure full and comparable coverage of the required knowledge criteria in every test.

The log of evidence must be submitted at gateway to Highfield and must be accompanied by the log evidence matrix. The matrix must be fully completed and signed by both the apprentice and the employer.

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Gateway

How to prepare for gateway

After apprentices have completed their on-programme learning, they should be ready to pass through 'gateway' to their end-point assessment.

Gateway is a meeting that should be arranged between the apprentice, their employer and training provider to determine that the apprentice is ready to undertake their end-point assessment.

The apprentice should prepare for this meeting by bringing along work-based evidence, including the completed:

- log of 13 to 15 pieces of evidence, detailing 1 piece of evidence holistically mapped to each knowledge, skill and behaviour that is assessed in the professional discussion
- project portfolio to evidence completion of an improvement project or projects that is the subject of the presentation and questioning

In advance of gateway, apprentices will need to have completed the following. The requirements for English and maths listed below are mandatory for all apprentices aged between 16-18 at the start of their apprenticeship training. The requirements for English and maths listed below are optional for apprentices aged 19+ at the start of their apprenticeship training.

- Achieved level 2 English
- Achieved level 2 maths

Therefore, apprentices should be advised by employers and providers to gather this evidence and undertake these qualifications during their on-programme training. It is recommended that employers and providers complete regular checks and reviews of this evidence to ensure the apprentice is progressing and achieving the standards before the formal gateway meeting is arranged.

The gateway meeting

The gateway meeting should last around an hour and must be completed on or after the apprenticeship on-programme end date. It should be attended by the apprentice and the relevant people who have worked with the apprentice on-programme, such as the line manager/employer or mentor, the on-programme trainer/training provider and/or a senior manager (as appropriate to the business).

During the meeting, the apprentice, employer and training provider will discuss the apprentice's progress to date and confirm if the apprentice has met the full criteria of the apprenticeship standard during their on-programme training. The **Gateway Readiness Report** should be used to log the outcomes of the meeting and should be agreed by all 3 parties. This report is available to download from the Highfield Assessment website.

The report should then be submitted to Highfield to initiate the end-point assessment process. If you require any support completing the Gateway Readiness Report, please contact your EPA Customer Engagement Manager at Highfield Assessment.

Please note: a copy of the standard should be available to all attendees during the gateway meeting.

Reasonable adjustments and special considerations
Highfield Assessment has measures in place for apprentices who require additional support. Please refer to the Highfield Assessment Reasonable Adjustments Policy for further information/guidance.

ID requirements
All employers are required to ensure that each apprentice has their identification with them on the day of assessment so the end-point assessor/Highfield Assessment can check that the person undertaking the assessment is indeed the person they are claiming to be.

Highfield Assessment will accept the following as proof of an apprentice's identity:

- a valid passport (any nationality)
- a signed UK photocard driving licence
- a valid warrant card issued by HM forces or the police
- another photographic ID card, such as an employee ID card or travel card

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The Improvement Practitioner apprenticeship standard

The following pages contain the Level 4 Improvement Practitioner apprenticeship standard and the assessment criteria in a format that is suitable for delivery.

Compliance
Multiple-choice examination
Knowledge
K1 Legislative and **customer compliance** requirements including health and safety
Assessment criteria
E1 Explain the **employer's main duties under the Health and Safety at Work Act** (K1) **E2** Critically evaluate the **customer compliance** requirements of the business (K1)
Amplification and guidance

Customer compliance
• Customer compliance requirements are typically derived from:
  ○ regulations by ensuring adherence to laws and industry-specific rules such as General Data Protection Regulations (GDPR) for data or International Organisation for Standardisation (ISO) certifications
  ○ contracts by meeting the agreed terms and conditions with customers including service-level agreements (SLAs)
  ○ customer expectations by aligning with customer-specific standards or codes of conduct
• Benefits of meeting customer compliance requirements include:
  ○ enhanced customer trust and loyalty
  ○ market competitiveness
  ○ reduced legal and financial risks
  ○ operational efficiency
• Challenges in achieving compliance:
  ○ the complexity and diversity of requirements
  ○ the cost of compliance
  ○ the time and resource intensity

- Risks of non-compliance:
    - legal consequences
    - loss of business
    - reputational damage
- Strategies for managing compliance:
    - proactive risk management
    - effective communication
    - automation and technology
    - training and awareness
- Critical considerations:
    - balancing flexibility and standardisation:
        - businesses must adapt to individual customer needs while maintaining cost-effective, standardised processes
    - sustainability and ethics:
        - customers increasingly expect compliance with not just laws but also ethical and sustainable standards, such as carbon footprint reduction
    - continuous improvement:
        - compliance is not a static, but a dynamic, process requiring ongoing monitoring, adaptation and improvement

Employer's main duties under the Health and Safety at Work Act

- Provide a safe working environment by:
    - ensuring that the workplace is free from hazards and that any risks to health and/or safety are properly controlled
    - maintaining safe access to and from the workplace
- Ensure the health, safety and welfare of employees and non-employees by:
    - providing and maintaining safe systems of work such as procedures, tools and equipment
    - minimising risks associated with machinery, hazardous substances or processes
    - safeguarding contractors, visitors, customers and the general public who may be affected by work activities
    - supplying appropriate personal protective equipment (PPE) to employees free of charge, where risks cannot be adequately controlled by other means
- Record and report injuries and conduct risk assessments:
    - comply with the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR)

- maintain accurate records of accidents and near misses
- identify potential risks in the workplace through regular and thorough risk assessments
- take steps to reduce or eliminate identified risks as far as is reasonably practicable

- Provide information, training and supervision:
  - inform employees about hazards and the measures in place to control them
  - provide adequate health and safety training and ensure employees understand their responsibilities
  - supervise work activities to ensure safety measures are being followed
  - involve employees and their representatives in discussions about health and safety matters
  - ensure workers have a voice in decision-making processes related to health and safety
  - for businesses with more than 5 employees, prepare a written health and safety policy

Project management

Multiple-choice examination

Knowledge

K3 Business case, **risk analysis and management**, toll-gate reviews, **work breakdown structure**, lessons learned, pilot studies, project review, **process management** and measures, **benefits tracking**

Assessment criteria

E3 Clarify the **business case** through **risk analysis and management** (K3)
E4 Describe the **toll-gate review process** (K3)
E5 Identify the purpose of creating a **work breakdown structure** (K3)
E6 Evaluate the use of **benefits tracking** in project management (K3)
E7 Explain the purpose of **process management** when managing projects (K3)

Amplification and guidance

Business case

- Outlines the justification for undertaking a project or initiative and typically includes:
    - objectives – what the project aims to achieve
    - benefits – the value it will deliver such as cost savings, improved efficiency or customer satisfaction
    - costs – resources required to implement the project
    - risks – potential challenges or uncertainties that could impact the project's outcomes
- To clarify a business case, identified risks must be connected to their potential outcomes and justify how the proposed mitigation measures will ensure success:
    - present the risks transparently:
        - use clear documentation such as a risk register or a risk log
        - communicate how the identified risks relate to the project's scope, timeline and deliverables
    - demonstrate mitigation strategies:
        - provide a step-by-step plan for addressing the risk(s)
        - include resource allocation and timelines for implementing risk mitigation
    - balancing risks and benefits:
        - justify why the benefits of the project outweigh the risks

        - highlight how effective risk management enhances the likelihood of achieving the desired outcomes
    - securing stakeholder confidence:
        - show how proactive risk management aligns with organisational goals and builds trust among stakeholders
        - highlight how risks are continuously monitored and managed throughout the project lifecycle

Risk analysis and management

- Key elements:
    - risk identification:
        - list all potential risks, such as financial, operational, technical or strategic risks that could affect the project
        - use tools such as:
            - mind mapping
            - strengths, weaknesses, opportunities, threats (SWOT) analysis
            - risk registers or checklists
    - risk assessment:
        - how likely is the risk to occur on a scale of low, medium or high
        - what would be the consequence if the risk materialises on a scale of minor, moderate or severe
        - use tools such as:
            - Probability-Impact Matrix – helps to prioritise risks based on their severity
            - Failure Mode and Effects Analysis (FMEA) – assesses risks associated with failures in processes or systems
    - risk mitigation and management:
        - develop strategies to manage risks including:
            - avoidance – eliminate the cause of the risk
            - reduction – take steps to minimise the likelihood or impact of the risk
            - transfer – share the risk, such as through insurance or outsourcing
            - acceptance – acknowledge and monitor the risk if it is low-impact or unavoidable
        - use tools such as:
            - action plans for each prioritised risk
            - contingency plans for high-impact risks
- Tools and techniques also include:
    - Risk registers

- Risk heat map
- Cost-benefit analysis
- Monte Carlo simulation

Work breakdown structure

- A hierarchical decomposition of a project into smaller, manageable components or tasks
- A tool in project management that helps teams organise and define the total scope of a project
- The purpose of creating a work breakdown structure (WBS) is to:
  - clearly define a project's scope
  - enhance a project's planning
  - improve communication
  - enable progress monitoring and control
  - facilitate risk management
  - support cost estimation
  - clearly assign responsibilities
- A typical WBS is hierarchical and may include the following levels:
  - project goal
  - deliverables – the main outcomes or products of the project
  - sub-deliverables – smaller components that contribute to the main deliverables
  - task/work packages – specific actions required to complete sub-deliverables
- Key characteristics of a WBS:
  - hierarchy – organised in levels with the project goal at the top and tasks/work packages at the bottom
  - 100% rule – covers 100% of the project scope, including all deliverables and tasks
  - mutually exclusive elements – tasks should not overlap to prevent duplication or confusion
  - outcome-oriented – focused on deliverables or results rather than processes

Process management

- The systematic planning, monitoring and control of processes to ensure that project objectives are met efficiently and effectively
- It provides a structured approach to project execution ensuring consistency, quality and alignment with organisational goals
- Its purpose in project management is to:

    - ensure consistency and standardisation by reducing variability in project outcomes, improving reliability
    - improving quality and efficiency by streamlining processes to reduce wasting time and resources and facilitating quicker decision-making
    - enable effective resource management
    - facilitate risk management
    - support continuous improvement
- Key elements of process management:
    - process design:
        - define the steps required to achieve project goals
        - includes inputs, outputs, roles and responsibilities
    - process implementation:
        - deploy the processes across the project team with clear instructions and tools
        - provide training to ensure everyone understands their role
    - process monitoring and control:
        - use metrics and KPIs to track performance and adherence to processes
        - identify and address deviations from the planned process
    - process review and improvement:
        - evaluate the effectiveness of processes post-project
        - incorporate feedback to enhance future projects

Benefits tracking

- The process of monitoring and measuring the tangible and intangible outcomes of a project to ensure that the desired benefits are achieved and aligned with organisational goals
- The purpose of benefits tracking is to:
    - ensure value is delivered, confirming that the project's outcomes align with the business case and expected benefits
    - help hold stakeholders accountable for achieving specific benefits
    - provide data to refine future projects by identifying what worked well and what did not
    - ensure resources are used efficiently to achieve the best possible outcomes
- Types of benefits in project management:
    - tangible benefits:
        - easily measurable and quantifiable

        - examples include cost savings, increased revenue and improved efficiency
    - intangible benefits:
        - more difficult to measure but equally important
        - examples include improved customer satisfaction, enhanced employee morale and brand reputation
- Key components of benefits tracking:
    - benefits identification:
        - clearly define expected benefits during the project initiation phase
        - link benefits to project objectives and organisational goals
    - benefits measurement:
        - develop key performance indicators (KPIs)
        - use both quantitative metrics such as financial performance and qualitative metrics such as stakeholder feedback
    - benefits realisation:
        - monitor benefits over time, even after the project is completed
        - compare actual outcomes with planned benefits to evaluate success
    - benefits reporting:
        - regularly communicate progress to stakeholders
        - use dashboards or reports to visualise data and trends
    - benefits optimisation:
        - identify areas for improvement or additional value generation during and after the project lifecycle
- Tools and techniques:
    - benefit realisation plans
    - dashboards and reporting tools
    - post-implementation reviews
    - cost-benefit analysis
    - stakeholder feedback

Toll-gate review process

- A structured framework used in project management to evaluate progress at key stages of a project
- Ensures that objectives are met before moving forward to the next phase
- Project stakeholders will assess:

    - the progress made during the current phase
    - the deliverables achieved against planned objectives
    - whether the project is ready to advance to the next stage
- At each toll-gate, stakeholders decide whether to:
    - proceed to the next phase
    - pause the project to address any issues
    - stop the project if it no longer aligns with goals or is unfeasible
- The purpose of the toll-gate review process is to:
    - confirm that the project stays aligned with business goals and customer needs
    - improve decision-making
    - identify and manage risks
    - enhance accountability
    - drive quality

Change management

Multiple-choice examination

Knowledge

K5 Stakeholder identification, analysis and management (RACI). Change curve, resistance characteristics, change sponsorship, **compelling point of view**

Assessment criteria

E8 Identify a key benefit of applying the **RACI model** to managing change (K5)
E9 Summarise typical responses to organisational and personal change as outlined in **change curve theory** (K5)
E10 Outline the role of the **sponsor** in managing change (K5)
E11 Explain **how the compelling point of view can support organisational change** (K5)

Amplification and guidance

Compelling point of view

- Clear, persuasive and emotionally engaging narrative that explains the need for change and inspires action
- Compelling reason for change, addresses resistance and fosters commitment by connecting the change initiative to an organisation's vision, values and objectives
- Elements of a compelling point of view:
    - vision – a clear description of the desired future state
    - reason for change – a strong case for why change is necessary now
    - benefits – a focus on how the change will improve outcomes for individuals, the team and the organisation
    - call to action – how leaders motivate stakeholders in the need for change
- Best practice for developing a compelling point of view:
    - understand the audience and tailor that message to address specific concerns and aspirations
    - use data and stories by combining facts and emotional appeal to create a balanced and credible narrative
    - continuously communicate the compelling point of view through various channels to keep it fresh and relevant

RACI model

- Used to clarify roles and responsibilities in a project or process, particularly during periods of change and stands for:
    - Responsible – the person/people who do the work to complete the task
    - Accountable – the individual ultimately answerable for the task's success or failure

    - Consulted – those whose input is sought to provide guidance or expertise
    - Informed – those who need to be kept up to date on progress or decisions
- Key benefits of applying the model:
    - it provides a clear framework that defines who does what, preventing duplication of effort and ensures no critical task is overlooked
    - reduces ambiguity by clearly outlining who is responsible for decisions, implementation and communication
    - improves accountability by ensuring that someone is accountable for the success of each task or change initiative
- It helps in change management by:
    - facilitating effective planning
    - clarifying communication responsibilities
    - supporting risk mitigation

Change curve theory

- A psychological model used to describe the stages individuals typically experience when adapting to change, both on a personal and organisational level
- Based on Kubler-Ross's Grief Cycle, which includes:
    - denial
    - anger
    - bargaining
    - depression
    - acceptance
- Typical organisational and personal responses:
    - organisational:
        - initial resistance from teams or departments
        - leadership facing criticism or pushback
        - decreased productivity during early stages
        - increased collaboration and innovation once the change is accepted
    - personal:
        - emotional highs and lows, ranging from fear to hope
        - concerns about job security, competence or relevance
        - varying adoption speeds depending on individuals' resilience and support

- Practical use of change curve theory in organisations:
    - anticipating resistance:
        - recognising that resistance (denial and/or anger) is a natural part of the process, not a sign of failure
        - providing space for feedback and addressing concerns constructively
    - tailored support at each stage:
        - offer clear communication to reduce uncertainty and align expectation during early stages
        - provide emotional support and practical help during middle stages
        - celebrate successes and recognise contributions to reinforce commitment during later stages
    - leaders can use the curve to gauge morale and adapt their strategies to support teams through each stage

Sponsor

- Key roles and responsibilities:
    - define the vision for change
    - align the change initiative with an organisation's strategic goals
    - set priorities to focus resources and efforts on the change initiative
    - champion the change
    - build stakeholder commitment by serving as a role model for others
    - resource allocation
    - decision-making
    - communication
    - accountability
    - support for the team
- Key attributes of an effective sponsor:
    - influence
    - commitment
    - engagement
- Impact of a strong sponsor:
    - reduced resistance through building trust and credibility
    - ensuring the alignment of a change initiative with organisational priorities
    - increased likelihood of successful implementation by securing resources and removing obstacles

- fosters a culture of accountability and continuous improvement

How the compelling point of view can support organisational change

- Creates a sense of urgency, motivating employees to act to reduce complacency or resistance
- Provides direction and focus, preventing misalignment and confusion by outlining the change
- Builds emotional connections by illustrating the benefits of change and making it relatable
- Inspires confidence and commitment by framing change positively to encourage stakeholders to embrace uncertainty
- Addresses fear of the unknown or lack of understanding by providing clarity and assurance
- Unifies diverse teams and departments under a shared vision
- A well-crafted compelling point of view reminds stakeholders of the broader purpose

Principles and methods
Multiple-choice examination
Knowledge
K6 Business value of **Lean** and **Six Sigma** improvement methods - 8D, practical problem solving, Define Measure Analyse Improve Control, Design for **Six Sigma**
Assessment criteria
E12 Explain the business value of **Six Sigma** methodology (K6) **E13** Evaluate the importance of **DMAIC phases** in **Lean Six Sigma** problem-solving (K6) **E14** Summarise the purpose of the **8D approach** to problem solving (K6) **E15** Explain the main principles and business value of **Lean** (K6)
Amplification and guidance

Lean
• Main principles:
  ○ identify value:
  ▪ define what constitutes value from the customer's perspective
  ○ map the value stream:
  ▪ analyse all the steps involved in delivering a product or service from start to finish
  ▪ categorise activities as:
  • value-added – activities directly contributing to the product or service value
  • non-value-added (waste) – activities that do not add value and should be minimised or eliminated
  ○ create flow:
  ▪ ensure that processes move smoothly and continuously without interruptions, delays or bottlenecks
  ○ establish pull:
  ▪ produce only what is needed when it is needed, based on customer demand rather than overproducing
  ○ pursue perfection:
  ▪ continuously seek ways to improve processes and eliminate waste
• Main types of waste (Muda):
  ○ Lean focuses on eliminating the 7 types of waste (TIMWOOD):

        - transportation – unnecessary movement of materials or products
        - inventory – excess stock that ties up capital and space
        - motion – unnecessary movement of people
        - waiting – idle time due to delays or bottlenecks
        - overproduction – producing more than is needed
        - overprocessing – performing more work than necessary
        - defects – errors requiring rework or causing dissatisfaction
- Business value of Lean:
    - increased efficiency
    - cost savings
    - improved quality
    - enhanced customer satisfaction
    - employee engagement
    - greater ability to respond quickly to changes in customer demand or market conditions
- Strategic importance:
    - By minimising waste, Lean supports environmental and financial sustainability
    - Lean organisations can deliver value faster and at lower costs giving them a competitive advantage
    - Continuous improvement drives innovation in processes, products and services

Six Sigma

- The core business value of Six Sigma includes:
    - enhanced process efficiency by identifying and removing variation
    - improved product and service quality
    - cost reduction through elimination of defects
    - increased customer satisfaction
    - data-driven decision-making
- Strategic business benefits:
    - the potential for competitive advantage
    - enhanced employee engagement as they see the impact of their contributions
    - scalability and sustainability

    - revenue growth
- Alignment with organisational goals:
    - enhancing financial performance through cost savings and efficiency gains
    - supporting customer focus by consistently meeting or exceeding quality expectations
    - fostering a culture of continuous improvement, which aligns with long-term growth goals

DMAIC phases

- DMAIC is a structured methodology to solve complex problems and achieve process improvements
- The 5 phases are:
    - Define – clearly define the problem, goals and scope of the improvement project
    - Measure – collect data to establish a baseline and quantify the current state of the process
    - Analyse – identify the root causes of the problem using data analysis and Lean Six Sigma tools
    - Improve – develop and implement solutions to address root causes and improve process performance
    - Control – ensure that improvements are sustained over time
- Importance of DMAIC phases:
    - ensures a systematic progression from problem identification to sustainable solution implementation
    - reliance of data ensures objectivity and accuracy in identifying and solving problems, reducing reliance on assumptions
    - applicable to both small-scale improvements and large-scale transformational projects
    - involves stakeholders throughout the process, increasing buy-in and support for changes

8D approach

- D0 – Plan for solving the problem and determine opportunities
- D1 – Establish the team:
    - form a cross-functional team with the knowledge, skills and authority to solve the problem
- D2 – Define the problem:
    - describe the problem in detail, including who, what, where, when, why and how it impacts the customer or business
- D3 – Implement interim containment actions (ICA):
    - take immediate steps to protect the customer and prevent the problem from worsening while the root cause is being identified
- D4 – Identify root causes:
    - use root cause analysis tools such as a Fishbone diagram to determine the true causes of the problem

- D5 – Develop permanent corrective actions (PCA):
    - identify and select solutions that eliminate root causes and prevent recurrence
- D6 – Implement PCA:
    - execute the corrective actions and validate their effectiveness through testing or monitoring
- D7 – Prevent recurrence:
    - modify processes, systems or controls to ensure the problem does not reoccur
- D8 – Recognise and celebrate team success:
    - acknowledge the team's efforts and document lessons learnt for future reference
- Key benefits include:
    - improving quality by reducing defects, inefficiencies and customer complaints
    - increasing customer trust by demonstrating a commitment to addressing and resolving issues effectively
    - preventing recurrence by focusing on long-term solutions rather than short-term fixes
    - encouraging collaboration by promoting teamwork across functions to develop comprehensive solutions
    - supporting continuous improvement by documenting findings and solutions to improve processes over time

Project selection and scope
Multiple-choice examination
Knowledge
K7 Y=f(x) equation (outputs are the result of inputs), business scorecard cascade
Assessment criteria
E16 Interpret the use of **Y=f(x)** equation in determining project selection (K7) **E17** Explain the benefits of **cascading the balanced scorecard** through the business through teams, and to individuals (K7)
Amplification and guidance

Y=f(x)

- Equation breakdown:
  - Y – the outcome that an organisation/individual wants to improve, such as customer satisfaction or revenue
  - f – represents the function or relationship between inputs and the output
  - x – the inputs that influence Y, such as process steps, resources or environmental factors
- In words, Y is a function of x, meaning that the outcome (Y) depends on 1 or more key inputs (x)
- Its purpose in project selection is to:
  - identify critical projects:
    - the Y=f(x) model helps organisations prioritise projects by focusing on factors that significantly affect critical outcomes
    - if Y is customer satisfaction, projects targeting inputs like delivery time, product quality and customer support are prioritised
  - quantifying impact:
    - provides a quantitative framework to estimate how changes in specific inputs (x) will influence the outcome (Y)
    - ensures selected projects have a measurable and direct effort on strategic goals
  - aligning with business goals:
    - projects are selected based on their alignment with organisational objectives by focusing on improving critical outputs (Y) that matter most to stakeholders
- Applying Y=f(x) in project selection:
  - define the outcome (Y):
    - start by identifying the key business metric or outcome that needs improvement such as:
      - reducing defect rates

            - increasing on-time delivery rates
            - improving customer satisfaction scores
    - identify potential inputs (x):
        - map out the factors that could influence the outcome using tools such as:
            - Process mapping
            - Fishbone diagrams
            - Suppliers, inputs, process, outputs, customers (SIPOC) models
    - analyse the relationship:
        - use data analysis and statistical tools, such as regression analysis or Design of Experiments, to determine which inputs have the strongest impact on the outcome
        - prioritise inputs that significantly affect Y

Cascading the balanced scorecard

- Involves breaking down organisational-level objectives into more detailed and actionable goals for departments, teams and individuals
- Each level supports the higher-level objectives, creating a clear line of sight from individual contributions to overall organisational success
- Benefits include:
    - strategic alignment
    - improved communication
    - enhanced accountability
    - focused efforts
    - enhanced performance measurement
    - employee engagement and motivation
    - continuous improvement
- How it works in practice:
    - at the organisational level:
        - develop the balanced scorecard with high-level strategic goals, such as customer satisfaction or internal processes
    - at the team level:
        - translate organisational goals into actionable team objectives, for example:
            - a customer satisfaction goal focusing on reducing response times by 20%
            - an internal process goal such as reducing manufacturing defects by implementing Lean practices

- at the individual level:
  - break team goals into personal goals for employees, for example:
    - a customer service representative aiming to respond to inquiries within 2 hours
    - a manufacturing worker focuses on adhering to new quality control protocols

Problem definition
Multiple-choice examination
Knowledge
K8 Cost of Poor Quality, problem analysis models such as **Is/Is Not**
Assessment criteria
E18 Define the meaning of **cost of poor quality** (K8) **E19** Evaluate **different problem analysis models**, for example, **Is/Is Not** (K8)
Amplification and guidance
Cost of poor quality • Refers to the total cost incurred by an organisation due to the failure to meet quality standards • These costs arise from defects, inefficiencies and errors in processes, products or services • Components include: o prevention costs associated with preventing defects or poor quality from occurring in the first place, for example: ▪ quality training for employees ▪ process improvement initiatives ▪ preventative maintenance o appraisal costs related to inspecting, testing and ensuring that quality standards are met, for example: ▪ quality audits ▪ product testing ▪ incoming material inspections ▪ calibration of measuring equipment o internal failure costs incurred when defects are detected before a product or service is delivered to the customer, for example:

        - scrap and rework
        - downtime due to quality issues
        - additional labour or materials to correct defects
        - wasted resources in production
    - external failure costs incurred when defects are discovered after the product or service is delivered to the customer, for example:
        - warranty claims
        - product recalls
        - loss of reputation or customer trust
        - legal penalties or liabilities
- Cost of poor quality (CoPQ) matters because:
    - it directly affects profitability by increasing operational costs
    - by addressing poor quality, waste is reduced and efficiency is improved
    - reducing CoPQ improves customer experience and loyalty
    - organisations with lower CoPQ can offer greater customer satisfaction and better quality at a lower price, creating a market advantage
    - monitoring CoPQ highlights inefficiencies and areas for improvement, driving innovation and process optimisation

Is/Is Not

- It is a comparative problem-solving method
- It is used to clearly define a problem by identifying what is 'is' versus what is 'is not'
- This approach eliminates irrelevant information, narrows the scope and prevents assumptions
- Key steps include:
    - defining the problem by answering what is the issue/what is not the issue
    - exploring key dimensions such as:
        - what is/is not affected
        - where does it/does it not occur
        - when does it/does it not occur
        - to what extent does it/does it not occur
- Benefits include:
    - helping to focus on specific aspects of a problem
    - reducing biases by separating assumptions from facts
    - ensuring thorough exploration of a problem's boundaries

- Drawbacks include:
    - it may not directly identify root causes without additional tools
    - it requires accurate data to be effective

Different problem analysis models

- Fishbone Diagram (Ishikawa Diagram):
    - a visual tool used to systematically identify potential causes of a problem, categorised into the 6 Ms:
        - man
        - machine
        - method
        - material
        - mother nature (environment)
        - measurement
    - benefits include:
        - encourages mind mapping to explore all possible causes
        - visual format makes it easy to understand and communicate
    - drawbacks include:
        - can generate too many potential causes, making prioritisation difficult
        - requires additional tools, such as Pareto Analysis, to identify the most likely root causes
- 5 Whys:
    - a simple, iterative method that involves repeatedly asking why to drill down to the root cause of a problem
    - benefits include:
        - quick and straightforward
        - helps uncover deeper, systematic issues
    - drawbacks include:
        - it risks oversimplifying complex problems
        - it can lead to subjective or biased conclusions if not based on evidence

Process mapping and analysis
Multiple-choice examination
Knowledge
K9 Swim lane, value stream map, performance metrics – continuous, **Parameter diagram**, **Takt time**, **Overall Equipment Effectiveness**, **theory of constraints** principles, **Kanban**
Assessment criteria
E20 Explain the purpose of **'swim lanes' in flow diagrams** (K9) **E21** Identify the objectives of **value stream mapping** (K9) **E22** Summarise the information shown in a **Parameter Diagram** (K9) **E23** Explain how **Takt time** is calculated (K9) **E24** Identify the three factors in **Overall Equipment Effectiveness** (K9) **E25** Evaluate the **Theory of Constraints** methodology in analysing processes (K9) **E26** Explain the use of the **Kanban** system in the manufacturing process (K9)
Amplification and guidance

Parameter diagram
• Also known as the P-diagram, it is used to visualise and analyse the inputs, outputs and influencing factors of a system, product or process
• Key components include:
  ○ inputs – factors that directly affect a system or process
  ○ outputs – desired results or responses the system is designed to produce
  ○ control factors – variables that can be adjusted or controlled to influence the outputs
  ○ noise factors – uncontrollable external or internal variables that may affect the system's performance
  ○ error states (failures) – potential undesirable outcomes or defects resulting from the system's operation
• A P-diagram is visually organised as:
  ○ it inputs feed into the system or process
  ○ control factors influence how the system operates
  ○ noise factors represent potential disturbances
  ○ outputs represent the intended results
  ○ error states highlight possible failures or undesired outcomes

Takt time

- Represents the pace at which a product must be completed to meet customer demand
- Ensures that production aligns with demand, reducing overproduction and underutilisation of resources
- Calculated by dividing the available time for production by customer demand:
    - available time for production refers to the actual working time during which production can take place
    - customer demand refers to the total number of units or outputs the customer requires in the same time frame
- An example calculation:
    - a factory operates for 8 hours per day (480 minutes) with 1 hour of breaks and customer demand is 240 units
    - 480 minutes – 60 minutes of breaks = 420 minutes, Takt time = 420/240 = 1.75 minutes per unit
    - the productions process must produce 1 unit every 1.75 minutes to meet customer demand

Overall Equipment Effectiveness

- Used to measure the efficiency and productivity of equipment
- Provides a comprehensive view by evaluating how effectively a manufacturing process utilises its equipment in relation to its full potential
- Overall Equipment Effectiveness (OEE) is expressed as a percentage, where 100% indicates that equipment is operating at maximum efficiency without any losses and is based on:
    - availability:
        - measures the percentage of scheduled production time that the equipment is available to operate using scheduled and operating times
        - scheduled time refers to the total time the equipment is planned to be in operation
        - operating time refers to the actual time the equipment is running, excluding downtime due to breakdowns, changeovers or maintenance
        - availability is calculated by dividing the operating time by the scheduled time and multiplying by 100
    - performance:
        - measures how well the equipment performs during operating time compared to its designed capacity using theoretical maximum and actual outputs
        - actual output refers to the number of units produced during operating time
        - theoretical maximum output refers to the maximum possible number of units equipment can produce at optimal speed
        - performance is calculated by dividing actual output by the theoretical maximum output and multiplying by 100

    - quality:
        - measures the proportion of good, defect-free units produced out of the total output using good units and total units produced
        - good units refer to the number of units that meet quality standards and do not require rework or rejection
        - total units produced refers to the total output, including defective products
        - quality is calculated by dividing good units by the total units produced and multiplying by 100
- Calculating OEE:
    - is the percentage determined by multiplying the 3 factors together as decimals, then multiplying the total by 100, for example:
    - if availability is 90%, performance is 85% and quality is 95%, then 0.9 x 0.85 x 0.95 = 0.72675 x 100 = 72.675%

Theory of Constraints

- Is a process improvement methodology that focuses on identifying and addressing the most significant limiting factor (or constraint) in a system
- It helps organisations maximise performance and achieve their goals by continuously improving the flow through their processes
- There are 5 steps, which include:
    - identify the constraint – find the bottleneck or limiting factor
    - exploit the constraint – maximise the utilisation of the constraint by optimising its capacity without significant investment
    - subordinate to the constraint – align all other processes to support the constraint's performance
    - elevate the constraint – invest in improvements to increase the constraint's capacity
    - repeat the process – once a constraint is resolved, a new one often emerges that requires continuous improvement
- Benefits of Theory of Constraints (TOC) in process analysis include:
    - focused improvement, ensuring maximum impact from changes and investments
    - by optimising the constraint, organisations can achieve better flow, minimise delays and increase overall output
    - it is simple and easy to use
    - the promotion of an iterative cycle of continuous improvement
    - it helps to optimise resources, focusing them on areas that drive the greatest value
- Challenges and limitations:
    - it requires accurate identification as misidentification can lead to wasted efforts and resources
    - it works best in stable environments where constraints can be reliably identified and addressed
    - elimination of the primary constraint may shift a bottleneck to another area, which will then need to be addressed

Kanban

- Designed to optimise workflow, minimise waste and ensure just-in-time (JIT) production
- Usually sorted into 3 columns - to-do, doing and done
- Key principles:
    - visual management – uses boards or cards to visually track the status of production and inventory levels
    - pull-based system – production is driven by customer demand rather than forecasting, ensuring materials and products are only produced when needed
    - work-in-progress limits – restricts the number of items being worked on simultaneously, avoiding overproduction
    - continuous improvement – encourages regular adjustments to improve workflow efficiency and responsiveness

'Swim lanes' in flow diagrams

- A visual tool used to organise processes by separating tasks, responsibilities or steps into distinct lanes
- The lanes are typically labelled to represent different roles, teams, departments or systems that provide clarity on who or what is responsible for each part of the process
- The purpose of swim lanes is to:
    - clarify responsibilities:
        - by clearly indicating who is responsible for each step in a process, reducing confusion
        - by helping to identify handoffs between roles or teams
        - enhance process visibility
        - identify bottlenecks and delays
        - improve communication
        - simplify complex processes
- Swim lanes work in flow diagrams by:
    - creating lanes:
        - dividing the flowchart into horizontal/vertical lanes
        - labelling each lane based on the role, team or system it represents
    - mapping the process:
        - placing tasks, decisions and processes within the appropriate swim lane
        - using arrows to show the sequence of steps and how they move between lanes
    - analysing:

        - reviewing the diagram to ensure all tasks are appropriately assigned and that the workflow makes sense

Value stream mapping

- Used to visualise, analyse and improve the flow of materials and information required to deliver a product or service to customers
- Helps organisations identify waste, inefficiencies and opportunities for improvement in their processes
- Key objectives of value stream mapping (VSM) are:
    - visualising the entire process:
        - providing a detailed map of all the steps in a process, from start to finish, including material/information flow
        - enabling stakeholders to see how processes connect and interact
    - identifying waste:
        - highlight non-value-added activities
        - categorise waste based on TIMWOOD
    - establishing a baseline:
        - create a current-state map to document how the process operates today
        - use this as a starting point for identifying gaps and improvement opportunities
    - improving flow and reduce lead time:
        - optimise the process by reducing bottlenecks and enhancing the flow of materials and information
        - decreases time required to deliver value to the customer
    - aligning teams and objectives:
        - promote cross-functional collaboration by involving all stakeholders in mapping and analysis
        - ensure everyone has a shared understanding of the process and improvement goals
    - enabling continuous improvement
    - supporting strategic decision-making

Data analysis

Multiple-choice examination

Knowledge

K10 Spreadsheets and pivot table analysis, statistical analysis software

Assessment criteria

E27 Explain the importance of **spreadsheets and pivot table analysis** (K10)
E28 Evaluate different **statistical analysis software** (K10)

Amplification and guidance

Spreadsheets and pivot table analysis

- Importance of spreadsheets:
  - data organisation and analysis:
    - store large volumes of data in a structured format
    - perform calculations using built-in functions and formulas
    - visualise trends and patterns with graphs and charts
  - automation
  - scenario planning
  - accessibility
- Importance of pivot table analysis:
  - allow users to summarise, analyse and interpret data dynamically, especially valuable when handling large datasets
  - data summarisation:
    - quickly group and summarise data without altering the original dataset
    - aggregate information using metrics like sum, average, count and percentage
  - customisable views
  - trend and pattern identification
  - create interactive reports
  - allows for efficient data analysis
- Business applications:
  - financial:
    - track budgets, expenses and revenue

        - create financial models and forecasts
    - operational:
        - monitor key performance indicators (KPIs)
        - analyse production data for efficiency improvements
    - sales and marketing:
        - evaluate sales performance by team, product or region
        - track campaign metrics
    - process improvement

Statistical analysis software

- Plays a critical role in processing and interpreting data that enables businesses to make informed decisions
- Common statistical analysis software tools include:
    - Microsoft Excel:
        - user-friendly, affordable and widely available
        - limited capabilities for advanced statistical modelling and large datasets may reduce performance
    - IBM SPSS Statistics:
        - highly intuitive interface, strong visualisation and reporting capabilities
        - high licensing costs and limited scripting flexibility compared to open-source tools
    - Statistical Analysis System (SAS):
        - reliable, secure and is widely used in industries requiring regulatory compliance
        - high licensing costs and less flexibility
    - Minitab:
        - easy to learn and is tailored for Lean and Six Sigma practitioners
        - is expensive for individual and group licenses
    - Tableau:
        - outstanding data visualisation capabilities and enables quick insights from large datasets
        - expensive licensing and is mainly a visualisation tool so is not as robust for deep statistical analysis

Measurement systems
Multiple-choice examination
Knowledge
K11 Repeatability and reproducibility principles
Assessment criteria
E29 Define the difference between **repeatability and reproducibility** when appraising measurement systems (K11)
Amplification and guidance

Repeatability and reproducibility
• Repeatability refers to the consistency of measurements taken by the same operator, using the same measurement instrument, under the same conditions, on the same item:
  ○ sources of variation appear through instrument or operator error during repeated measurements
• Reproducibility refers to the consistency of measurements taken by different operators, using the same measurement instrument, under similar conditions, on the same item:
  ○ sources of variation appear through operator skill, technique or environmental factors
• Importance in measurement system analysis:
  ○ measuring repeatability:
  ▪ ensures the instrument provides consistent results
  ▪ identifies potential issues with the calibration or precision of the tool
  ○ measuring reproducibility:
  ▪ confirms the reliability of measurements across multiple operators
  ▪ identifies training or procedural inconsistencies among personnel
• Practical application:
  ○ Gage Repeatability and Reproducibility (Gage R&R) studies combine both elements to evaluate a measurement system's reliability
  ○ its purpose is to assess whether the measurement system variation is within acceptable limits relative to the process variation
  ○ steps include:
  ▪ selecting a sample of items to measure
  ▪ having multiple operators measure each item multiple times
  ▪ analysing the data to separate repeatability and reproducibility variations

Basic statistics and measures
Multiple-choice examination
Knowledge
K12 Control charts - attribute data, principles of normality
Assessment criteria
E30 Explain the outputs of a **control chart** (K12)
Amplification and guidance

Control chart
• A statistical tool used to monitor the stability of a process over time
• Helps to identify whether a process is operating within its expected limits or if it is subject to special cause variation
• The outputs provide insights into process performance, stability and areas requiring improvement
• Key outputs include:
  ○ data points:
  ▪ individual measurements or averages of a process metric plotted on a chart over time
  ○ centre line (CL):
  ▪ represents the process average (mean) or target value
  ▪ acts as a reference point for comparing individual data points
  ▪ a stable process will have most data points clustered around the centre line
  ○ upper control limits (UCL):
  ▪ the upper boundary, typically set at 3 standard deviations above the centre line
  ▪ data points above the UCL indicate a potential issue (special cause variation) identifying out-of-control conditions
  ○ lower control limits (LCL):
  ▪ the lower boundary, typically set at 3 standard deviations below the centre line
  ▪ data points below the LCL indicate a potential issue (special cause variation) identifying out-of-control conditions
  ○ patterns and trends:
  ▪ random patterns indicate normal variation (common causes)
  ▪ non-random patterns suggest special causes requiring investigation
  ○ process stability indicators:

        - the control chart as a whole indicates whether the process is stable (in control) or unstable (out of control)
        - a stable process has data points within control limits and no significant patterns
        - an unstable process exhibits points outside control limits or identifiable trends
- Types of control charts and their outputs:
    - X-Bar and R Chart:
        - Monitors the mean (X-Bar chart) and variability (R chart) of a process
        - X-bar charts measure the average of subgroups over time
        - R charts measure the range of variability within subgroups
    - Individuals and moving range chart (I-MR):
        - Monitors individual data points and variability
        - I-charts measure individual measurements
        - MR charts measure differences between successive measurements
    - Proportion chart (P-chart)
        - monitors the proportion of defective items in a process
        - measures control limits based on binomial distribution
    - C or U chart:
        - monitors the count of defects per unit (C chart) or defects per opportunity (U chart)
- Control chart outputs are used in decision-making to:
    - identify outliers
    - monitor process stability
    - diagnose root causes
    - aid with continuous improvement

Data analysis – statistical methods

Multiple-choice examination

Knowledge

K13 Measures of central tendency and **spread**

Assessment criteria

E31 Identify the three main **measures of central tendency** (K13)
E32 Evaluate the **relationship between the measure of spread and the measure of central tendency** in data analysis (K13)

Amplification and guidance

Measures of central tendency

- Statistical metrics that describe the central point or typical value of a dataset
- They summarise data by providing a single value that represents the centre of a distribution
- The 3 main measures are:
    - mean (arithmetic average):
        - the sum of all data points divided by the number of data points
        - sensitive to outliers (extreme values can skew the mean)
        - commonly used for interval and data ratio
    - median:
        - the middle value in an ordered dataset, separating the data into 2 equal halves
        - less affected by outliers compared to the mean, so is ideal for ordinal data or skewed distributions
        - if the number of data points is odd, the median is the middle value
        - if the number of data points is even, the median is the average of the 2 middle values
    - mode:
        - the mode is the most frequently occurring value(s) in a dataset
        - there can be no mode, 1 mode (unimodal) or multiple modes (bimodal or multimodal)
        - suitable for nominal, ordinal and some interval/ratio data

Spread

- Indicates the dispersion or variability around that central value
- Key measures of spread include:

- range:
  - difference between the minimum and maximum values
  - indicates the extent of the dataset but is highly sensitive to outliers
- interquartile range (IQR):
  - measures the spread of the middle 50% of data (difference between the 25^{th} percentile and the 75^{th} percentile)
  - robust against outliers
- variance:
  - average squared deviation of each data point from the mean
  - measures how far data points are from the mean in squared units
- standard deviation (SD):
  - square root of the variance, representing the average deviation from the mean in the original units
  - widely used in conjunction with the mean
- coefficient of variation (CV):
  - standard deviation expressed as a percentage of the mean
  - useful for comparing variability across datasets with different units or scales

Relationship between the measure of spread and the measure of central tendency

- Understanding data distribution:
  - central tendency provides a reference point such as the average or typical value
  - the measure of spread explains how much variation exists around those points
  - together they describe a dataset's shape, scale and reliability
- Spread provides context to central tendency:
  - a small spread, such as a low standard deviation, indicates that most data points are close to the central value, suggesting a consistent process or dataset
  - a large spread indicates greater variability, meaning the central tendency may not represent the dataset well
- Sensitivity to outliers:
  - measures like the mean are sensitive to outliers, which can inflate the spread
  - using the median as the measure of central tendency with the IQR as the measure of spread provides robustness in skewed datasets
- Implications for data shape:
  - symmetrical/normal distribution:

        - the mean, median and mode align and the spread is evenly distributed
    - skewed distribution:
        - the mean shifts toward the tail while the median remains closer to the central mass of data
        - spread measures like IQR or SD highlight the degree of asymmetry
- Practical applications in data analysis:
    - comparing datasets
    - process control:
        - a low spread (small SD) around the mean in a production process indicates consistent quality
        - a high spread signals issues like machine variability or material inconsistencies
    - risk assessment:
        - in financial data, the central tendency is useful for planning, but the spread is critical for assessing risk

Process capability and performance
Multiple-choice examination
Knowledge
K14 Capability analysis – **continuous data** for normal distribution
Assessment criteria
E33 Explain the purpose of a **process capability analysis** (K14) **E34** Explain why **continuous data** is used in capability analysis (K14)
Amplification and guidance

Continuous data
• A type of quantitative data that can take any value within a given range and is infinitely divisible
• Preferred in capability analysis because it:
  ○ provides a detailed picture of process variation:
  ▪ continuous data captures the degree of variability in a process more effectively than categorical or discrete data
  ▪ it allows for the calculation of key statistical measures like mean, standard deviation and variance, which are essential for assessing process capability
  ○ enables calculation of process capability indices:
  ▪ capability indices rely on precise measurements of the process distribution
  ▪ continuous data supports these calculations by defining the spread of data (standard deviation) and comparing the process performance to specification limits
  ○ fits statistical assumptions
  ○ supports predictive analysis
  ○ enhances precision in process understanding
  ○ is useful for identifying small changes
  ○ facilitates visualisation using tools such as histograms or control charts
 	
Process capability analysis
• A statistical method used to determine how well a process performs relative to specified limits or requirements
• It measures a process's ability to produce outputs that meet customer or specification standards consistently

- The purpose of process capability analysis (PCA) is to:
    - assess process performance:
        - PCA evaluates whether a process can consistently operate within predefined specification limits
        - It provides a quantitative measure of process consistency and stability
    - determine capability relative to specifications:
        - compares the spread of process variation (actual performance) to the allowable range defined by upper and lower specification limits
    - identify opportunities for improvement:
        - PCA highlights processes that are underperforming or require optimisation
        - It pinpoints areas where reducing variation or shifting the process mean could improve results
    - support decision-making:
        - guides strategic decisions, such as investments in process improvements, equipment upgrades or training programmes
        - provides evidence for accepting or rejecting a process during qualification or validation phases
    - monitor quality over time:
        - by tracking process capability indices such as capability index (Cp) or capability index centred (Cpk), PCA helps monitor process health and ensures quality standards are maintained
- Key concepts in PCA:
    - specification limits:
        - Upper specification limit (USL) represents the maximum acceptable value
        - Lower specification limit (LSL) represents the minimum acceptable value
        - PCA checks whether the process output falls within these limits
    - process spread:
        - represented by the process standard deviation (σ)
        - a narrower spread indicates less variability and higher capability
    - process centring:
        - how closely the process mean (μ) aligns with the target value
        - a well-centred process is more likely to meet specifications
    - capability indices:
        - capability index (Cp):
            - measures the process spread relative to specification limits

        - a Cp > 1 indicates the process spread is within specification limits
    - capability index centred (Cpk):
        - accounts for process centring and measures how close the mean is to the nearest specification limit
        - a Cpk > 1 indicates both a centred and capable process
- Applications of PCA:
    - manufacturing:
        - ensures that parts produced meet design tolerances
        - reduces defect rates and waste
    - service industries:
        - analyses process consistency
        - identifies areas for efficiency improvements
    - new process validation:
        - PCA is often used during the introduction of new processes to verify they meet capability requirements
    - regulatory compliance:
        - many industries use PCA to comply with strict quality standards

Root cause analysis
Multiple-choice examination
Knowledge
K15 Key principles including symptoms, failure-mode, potential/verified cause, critical inputs, **escape point**. Graphical representation of data with dot, scatter and box plots
Assessment criteria
E35 Explain the difference between **failure mode, failure cause and failure effect** (K15) **E36** Explain the objective of verifying potential **root causes** of a problem (K15) **E37** Evaluate the importance of understanding the **critical inputs of a process** (K15) **E38** Define the term '**escape point**' in a control system (K15) **E39** Identify the advantages of **visually representing data** in graphical form (K15)
Amplification and guidance
Escape point • A stage or location in a process where a defect, error or failure manages to bypass detection mechanisms and continues through the process • Is a point where the system fails to identify and contain an issue that can potentially cause larger problems later in the process • Characteristics: o failure to detect, which represents a breakdown in quality control or inspection at a specific point in the process o identifying escape points is critical for strengthening detection mechanisms and preventing further issues o if not addressed, they can lead to defective products or services reaching the customer, affecting satisfaction and compliance **Failure mode, failure cause and failure effect** • Failure mode: o the specific way in which a component, system or process could fail to perform its intended function o describes the observable malfunction or deviation o often relates to the function of an item • Failure cause: o the underlying reason or root cause for the failure mode o identifies the factors or conditions that lead to the failure mode

- can be linked to design flaws, material defects, human error, environmental factors or improper use
- Failure effect:
  - the consequences or outcomes of the failure mode on the system, process or customer
  - describes the impact of the failure on performance, safety or reliability
  - helps to assess the severity of the failure and prioritise corrective actions

Root causes

- The objective of verifying potential root causes of a problem is to ensure that the true cause of the issue is identified and confirmed before implementing corrective actions
- Key objectives:
  - validate hypotheses:
    - during root cause analysis, multiple potential causes may be identified
    - verification tests these hypotheses to confirm which cause(s) is responsible for the problem
  - prevent misdiagnosis:
    - ensures that time and resources are not spent solving unrelated problems
    - avoids implementing ineffective or counterproductive solutions
  - prioritise corrective actions
  - enhance process understanding
  - ensure long-term effectiveness
- Verification methods include:
  - data analysis
  - testing and experimentation
  - cause-and-effect diagrams
  - process observation
  - historical comparisons

Critical inputs of a process

- Essential for ensuring that a process performs as expected and delivers consistent, high-quality outputs
- Understanding critical inputs:
  - ensures process stability

    - enhances quality
    - facilitates problem-solving
    - optimises resource allocation
    - supports risk management
    - enables continuous improvement
- Challenges in identifying critical inputs include:
    - complexity, as processes with numerous variables can make it difficult to identify which inputs are critical
    - measurement limitations, as some inputs may be challenging to measure or control accurately
    - interdependencies, as inputs may interact making it hard to isolate their individual effects

Visually representing data

- Simplifies complex data into a clear, visual format that is easier to interpret
- Speeds up decision-making as trends, outliers or performance metrics can be quickly assessed
- Improves communication as visual data is effective for presentations and reports
- Graphical formats allow for straightforward comparisons between datasets or variables
- Enhances memory retention
- Well-designed visuals make insights actionable by clearly illustrating areas that require improvement or opportunities for growth
- Common visual/graphical formats include:
    - line graphs
    - bar charts
    - pie charts
    - scatter plots
    - histograms
    - control charts

Experimentation
Multiple-choice examination
Knowledge
K16 Active versus passive analytics, **design of experiments**, experiment plan
Assessment criteria
E40 Explain the difference between **active and passive analytics** (K16) **E41** Describe the purpose of **design of experiments** (K16) **E42** Evaluate the **purpose of designing an experiment plan** (K16)
Amplification and guidance

Design of experiments
• Is a structured, statistical approach used to systematically plan, conduct and analyse experiments to identify and understand the factors that influence a process or outcome
• Key purposes include:
  ○ identifying key factors influencing a process
  ○ understanding interactions between variables
  ○ optimising processes or products
  ○ reducing costs and effort
  ○ enhancing predictive capability
  ○ supporting problem-solving and root cause analysis
• Core steps of design of experiments (DOE) include:
  ○ defining the objective:
  ▪ clearly outlining the problem or question to be addressed
  ○ identifying factors and levels:
  ▪ determining the variables to test (factors) and their possible settings (levels)
  ○ designing the experiment:
  ▪ plan the experiment using a statistical design such as full/fractional factorial or response surface methodology
  ○ conducting the experiment:
  ▪ execute the tests according to the design
  ○ analyse the results:

        - use statistical methods to interpret the data and identify significant factors and interactions
    - implement improvements:
        - apply insights to optimise processes or resolve issues

Active and passive analytics

- 2 distinct approaches to data analysis, differentiated by how data is used and the actions triggered by the insights derived from it
- Both play critical roles in decision-making but serve different purposes, depending on the needs of a business or organisation
- Active analytics:
    - refers to the real-time or near-real-time collection, analysis and use of data to drive immediate actions or decisions
    - often involves automated systems that respond to data as it is generated
    - key characteristics include:
        - proactive – designed to trigger actions based on insights or anomalies detected in real-time
        - often integrated with systems that can execute decisions or adjustments automatically
        - relies on live data streams and immediate analysis
        - focused on taking corrective or optimising actions without significant delay
- Passive analytics:
    - refers to the collection and analysis of data for retrospective review and decision-making
    - focuses on understanding past trends, patterns or performance to inform future strategies
    - key characteristics include:
        - reactive – provides insights based on historical data rather than driving immediate action
        - often requires human intervention to interpret data and make decisions
        - focused on understanding long-term patterns, behaviours and correlations
        - used for strategic planning reporting and optimisation over time

Purpose of designing an experiment plan

- Ensuring that the experiment is conducted systematically, efficiently and effectively to obtain valid, reliable and actionable results
- A detailed experiment plan sets a clear framework for experimentation, outlines the resources needed and ensures the findings lead to meaningful conclusions
- Key reasons why designing an experiment plan is essential:
    - provides clear objectives and focus:

        - outlines what the experiment is trying to achieve
        - the experiment remains aligned with organisational goals
        - results will provide relevant insights that can drive informed decision-making
    - ensures proper experimental design:
        - ensures data collection is valid and reliable
        - prevents biases and ensures variables are tested properly
    - optimises resource allocation
    - controls variables and ensures validity:
        - ensures that the outcomes can be attributed to the factors being tested rather than uncontrolled variables
    - establishes statistical rigor
    - facilitates repeatability and reproducibility
    - reduces risk of bias and errors
    - enhances communication and collaboration
    - supports decision-making and continuous improvement

Identification and prioritisation
Multiple-choice examination
Knowledge
K17 Selection and prioritisation matrix, **Failure Mode and Effects Analysis**
Assessment criteria
E43 Identify factors to consider when **selecting improvement projects** (K17) **E44** Summarise the purpose of **Failure Mode and Effects Analysis** (K17)
Amplification and guidance

Failure Mode and Effects Analysis
• The purpose of failure mode and effects analysis (FMEA) is to:
  ○ identify potential failure modes:
  ▪ helps teams systematically identify ways in which a process, product or system might fail, ensuring risks are addressed before they occur
  ○ analyse the effects of failures:
  ▪ it evaluates potential consequences or impacts of each failure mode on operations, safety or customer satisfaction, which helps to prioritise which risks to address based on their severity
  ○ assess risk levels:
  ▪ FMEA uses a scoring system based on 3 factors:
  • severity (S) – impact of the failure
  • occurrence (O) – likelihood of the failure happening
  • detection (D) – likelihood of identifying the failure before it causes harm
  ▪ this scoring provides a quantifiable way to rank and prioritise risks
  ○ drive preventative action:
  ▪ it guides the development of strategies to mitigate or eliminate failure modes through design improvements, process changes or additional controls
  ▪ this reduces the likelihood of impact of the failures which improves reliability, safety and customer satisfaction
  ○ improves communication and collaboration
  ○ supports regulatory compliance
  ○ facilitates continuous improvement

Selecting improvement projects

- Crucial for maximising the value of an organisation's resources and achieving impactful outcomes
- Key factors to consider:
    - the alignment with business goals:
        - ensures the project contributes to overall business success and secures management support
    - impact on established key performance indicators (KPIs):
        - focuses efforts on projects that deliver measurable results and value
    - customer value:
        - enhances customer satisfaction and loyalty leading to long-term business growth
    - return on investment (ROI):
        - ensures the project delivers financial benefits and justifies resource allocation
    - feasibility:
        - avoids selecting projects that are overly ambitious or unlikely to succeed due to limitations
    - risk assessment:
        - helps in selecting projects with manageable risks or developing mitigation strategies for higher-risk initiatives
    - resource availability:
        - ensures that an organisation can effectively execute the project without overextending resources
    - stakeholder support:
        - projects with strong stakeholder support are more likely to succeed due to alignment and collaboration
    - urgency:
        - ensures that critical or time-sensitive opportunities are addressed promptly
    - scalability and replicability:
        - maximises the long-term impact and value of the improvement initiative
    - complexity and timeline:
        - avoids selecting projects that are too complex or have unnecessarily long timelines without delivering incremental value
    - competitive advantage:
        - projects that strengthen market position contribute to long-term success
    - environmental and social impact:
        - aligns with corporate social responsibility (CSR) objectives and enhances brand reputation

Project report, presentation and questioning		
Knowledge	**Skills**	**Behaviours**
K2 Decision-making techniques e.g. consensus, authority rule, majority rule **K4** Reporting templates, message mapping, case for change	**S1** Work in accordance with organisational controls and statutory regulations **S4** Define, sequence, plan and schedule activities with phases and milestones. Estimate effort and duration. Create and update project charter. Review progress **S5** Sponsorship contract, surface and manage resistance, build compelling narratives for change, assess change impact **S6** Select and apply a structured method and appropriate improvement tools engaging with subject matter experts to deliver business benefits **S7** Support the identification of improvement opportunity and the scoping of these projects **S8** Support development of problem/opportunity statements **S9** Support application of techniques to identify and prioritise customers, their requirements and ensure balance against the stated and unstated needs of the business (Voice of the Business)	**B1** Continuous drive for change and encourages others to deliver results across functional areas capturing and standardising best practice **B4** Proactively seeks and acts on feedback. Reflects on performance and has a desire for development. Adapts quickly to working with new situations/stakeholders/challenges

	S10 Process map to measure and analyse flow and value. Identify interfaces, functional responsibilities and ownership. Use insight to identify potential opportunities and map future state **S11** Seek in-process waste through understanding of value within the value stream **S12** Plan, carry out and assess results of a measurement system study **S13** Develop a sampling strategy **S14** Use graphical analysis to understand distribution and stability **S15** Identify data-types and select analysis methods and tools. Assess time series data stability and analyse making relevant insight **S16** Select methods and metrics for analysis **S17** Select and apply the appropriate graphical tool dependent on the data type to identify patterns, trends and signals to establish hypothesis **S18** Plan designed experiment with clear objectives, and appropriate levels of Measurement Systems Analysis, analyse experiment data and optimise **S19** Identify and prioritise factors, ideas and solutions	

	S20 Select and apply appropriate tools for ongoing monitoring and control. Analyse and interpret control charts **S22** Identify failure modes and embed learning from improvements	
Pass criteria	**Merit criteria**	***Distinction criteria***
PR1 Show **business benefit** to the apprentice's employer (S22) **PR2** Follow the **steps of a recognised problem-solving methodology** (e.g. PPS, DMAIC, 8D) with a clear flow from one step to another and supported by the application/interpretation of appropriate Lean, Six Sigma, project management and change management tools (S1, S4, S5, S6, S7, S8, S9, S10, S11, S19, S22) **PR3** Demonstrate **data-backed decision-making** to support definition, measurement, analysis and improvement (S12, S13, S14, S15, S16, S17, S18, S20) **PR4** Explanation of how they chose and scoped the project (S7) **PR5** How they used each tool (S6) **PR6** How they led a **cross-functional team** during the project (K2, K4) **PR7** How they coached colleagues in the application of improvement tools (S3)	**PR8** Clearly explains how the outputs of each tool are used to inform the next step (S7, S8, S9, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S22) **PR9** Identifies and takes the opportunity to share and/or replicate the improvements made to one other area/system, where there are differences in the solutions/controls required to deliver successful outcomes (B1)	***PR10** Identifies and takes the opportunity to share and/or replicate the improvements made to one other area/system, where there are differences in baseline metrics (B1)* ***PR11** Seeks opportunities to apply Lean, Six Sigma, project and change management tools in daily work (B4)*

Amplification and guidance

Business benefit
• A measurable outcome following a decision or action
• Often measured in financial terms, qualitative measures are also used to show a business benefit such as staff satisfaction
 	
Steps of a recognised problem-solving methodology
• Examples include:
  ○ Practical Problem Solving (PPS):
  ▪ the eight-step approach to practical problem-solving
  ▪ at each stage, appropriate project management tools are used according to the complexity of the problem, the root cause and the countermeasures required
  ○ Define, Measure, Analyse, Improve and Control (DMAIC):
  ▪ the interconnected phases of a six-sigma project - Define, Measure, Analyse, Improve and Control
  ▪ each step in the DMAIC process is required to ensure the best possible results, and uses a variety of tools and techniques at each stage appropriate to the problem or project
  ○ Eight Disciplines (8D):
  ▪ a method to approach and resolve problems
  ▪ focuses on product and process improvement to identify, correct and eliminate recurring problems
  ▪ establishes a permanent corrective action based on statistical analysis of the problem and on the origin of the problem by determining the root causes
 	
Data-backed decision-making
• Decisions made as a response to data analysis such as, problem definition, capability analysis, strategic objectives, project selection, key performance indicators
• This data analysis can be descriptive, predictive or prescriptive
 	
Cross-functional team
• A team made of members from different functional areas of the business such as sales, finance, human resources and production, who come together to form a project team

Professional discussion underpinned by log		
Knowledge	**Skills**	**Behaviours**
K2 Decision-making techniques e.g. consensus, authority rule, majority rule	**S2** Speak and write clearly. Influence others, question effectively. Plan and deliver meetings presenting insight to engage audiences **S3** Observe, listen, use questioning, provide feedback and spot learning opportunities **S4** Define, sequence, plan and schedule activities with phases and milestones. Estimate effort and duration. Create and update project charter. Review progress **S5** Sponsorship contract, surface and manage resistance, build compelling narratives for change, assess change impact **S18** Plan designed experiment with clear objectives, and appropriate levels of Measurement Systems Analysis, analyse experiment data and optimise **S21** Conduct structured benchmarking to support target setting	**B1** Continuous drive for change and encourages others to deliver results across functional areas capturing and standardising best practice **B2** Awareness of own and others' working styles. Creates high performing team **B3** Promotes a moral, legal and socially appropriate working manner, aligns behaviours to the organisation's values. Maintains flexibility to needs of project **B4** Proactively seeks and acts on feedback. Reflects on performance and has a desire for development. Adapts quickly to working with new situations/stakeholders/challenges **B5** Ensures safety of self and others, speaks out to challenge safety issues

Pass criteria	Merit criteria	*Distinction criteria*
PD1 Continuously drives for change and encourages others to deliver results across functional areas and standardises best practice (B1) **PD2** Demonstrate awareness of their own and others' working styles to create a high performing team (B2) **PD3** Promotes a moral, legal and socially appropriate working manner, aligned to the organisation's values and maintains flexibility to the needs of the project (B3) **PD4** Critically evaluates their improvement journey and identifies recommendations for improvement/change (e.g. "If I were to do this again I would…") (B4) **PD5** Proactively seeks and acts on feedback. Reflects on performance and demonstrate the desire for development. Adapts quickly to working with new situations, stakeholders and challenges (B4) **PD6** Ensures the safety of themself and others and speaks out to challenge safety issues (B5) **PD7** Clearly explains methods used for making decisions in the project team (K2) **PD8** Clearly explains how they engaged and influenced others (S2)	**PD14** Identifies opportunities for cross-functional improvement (B1) **PD15** Supports delivery of business-wide improvement projects led by improvement experts (B4)	***PD16*** *Takes the opportunity to prepare and/or deliver training to upskill colleagues (B1)* ***PD17*** *Seeks opportunities to involve others in building a continuous improvement culture (B4)*

PD9	Clearly explains their coaching skills by observing, listening, using questioning, providing feedback and spotting learning opportunities (S3)		
PD10	Clearly explains their approach to Project Management (S4)		
PD11	Clearly explains their approach to **Change Management** (S5)		
PD12	Designs an experiment with clear objectives. Conducts a **measurement system analysis** to ensure the integrity of data collected under the experiment. Analyses the results of the experiment data to identify opportunities to optimise processes or improve products (S18)		
PD13	Clearly explains their use of **benchmarking** to inform target setting and improvement options (S21)		

Amplification and guidance

Change management

- A systemic approach to managing a transition from one state to another within an organisation
- There are many management models in place to reference, such as:
    - Kotter's 8-Step Theory
    - Kubler-Ross' Change Curve Theory
    - Lewin's Change Management Model

Measurement system analysis

- Seeks to show the accuracy/inaccuracy of the measurement system used in experiments or other data collection processes
- Measurement system analysis (MSA) is focused on:
    - finding the amount of variation in a process

- examining repeatability, reproducibility, precision and stability
- Gage R&R is an example

Benchmarking

- Used to select suitable metrics and targets for improvement
- Establishes a baseline for the project and, where applicable, identifies key performance indicators at an organisational level

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Assessment summary

The end-point assessment for the Level 4 Improvement Practitioner apprenticeship standard is made up of 3 components.

1. **40-minute** multiple-choice examination
2. **40-minute** presentation and **35 minutes** questioning based on an improvement project report
3. **60-minute** professional discussion underpinned by log

The presentation and questioning around the project report and the professional discussion underpinned by log can take place on the same day. They must take place during month **2** of the end-point assessment window with a minimum of **2 weeks'** notice period given to the employer.

The multiple-choice examination can take place at any point during the end-point assessment window.

As an employer/training provider, you should agree a plan and schedule with the apprentice to ensure all assessment components can be completed effectively.

Multiple-choice examination

The multiple-choice examination will contain 40 knowledge-based questions and have a time limit of **40 minutes**.

The multiple-choice examination is an open-book exam. Reference books can be used but access to the internet is prohibited.

Multiple-choice examination		
Pass	**Merit**	**Distinction**
25-29 marks	30-35 marks	36-40 marks

Project report, presentation and questioning

The project report, presentation and questioning is weighted at 60% of the end-point assessment.

- To achieve a **pass**, apprentices must achieve all the pass criteria
- To achieve a **merit**, apprentices must achieve all the pass criteria and all the merit criteria
- To achieve a **distinction**, apprentices must achieve all the pass criteria, all the merit criteria and all the distinction criteria

The project report, presentation and questioning can be conducted face-to-face or remotely, as long as fair assessment conditions are maintained.

Professional discussion underpinned by log

The professional discussion underpinned by log is weighted at 30% of the end-point assessment.

- To achieve a **pass**, apprentices must achieve all the pass criteria
- To achieve a **merit**, apprentices must achieve all the pass criteria and all the merit criteria
- To achieve a **distinction**, apprentices must achieve all the pass criteria, all the merit criteria and all the distinction criteria

The professional discussion can be conducted face-to-face or remotely, as long as fair assessment conditions can be maintained.

Grading

Each assessment method will be individually graded in line with the conditions outlined above as fail, pass, merit or distinction.

Points will be awarded for each grade achieved in each individual assessment component using the table below.

Assessment component	Points awarded		
	Pass	Merit	Distinction
Multiple-choice examination	10	20	30
Project report, presentation and questioning	60	120	180
Professional discussion underpinned by log	30	60	90

Points for each assessment component will be added together to determine the overall grade using the table below:

Total points achieved	Overall grade
Below 100	Fail
100 or above	Pass
200 or above	Merit
260+	Distinction

Apprentices **must** achieve a minimum of a pass in each assessment component to pass the EPA overall.

Retake and resit information

Apprentices that fail the EPA will have the opportunity to resit/retake. A resit does not require further learning, whereas a retake does.

Apprentices who fail 1 or more EPA method will be offered the opportunity to take a resit or retake at the employer's discretion. The apprentice's employer needs to agree that a resit or retake is appropriate.

A resit is typically taken within **3 months** of the end-point assessment outcome notification. The timescale for a retake is dependent on how much retraining is required and is typically taken **within 6 months** of the end-point assessment outcome notification. Failed assessment methods must be resat or retaken **within a 6-month period** from the end-point assessment outcome notification, otherwise the entire end-point assessment will need to be resat or retaken in full.

If the apprentice fails the project assessment method, they must amend the project output in line with the assessor's feedback. The apprentice will be given **4 weeks** to rework and submit the amended report.

The apprentice will get a **maximum EPA grade of a pass** for a resit or retake, unless Highfield determines there are exceptional circumstances.

Resits and retakes are not available to apprentices wishing to move from pass to a higher grade, or from a merit to a distinction.

When the apprentice is ready to complete their resit or retake, please contact the Highfield scheduling team to discuss this further. Feedback will be provided on the areas of failure and a retake checklist will need to be submitted when the professional review has taken place.

When the apprentice is undertaking their resit or retake, the assessment method(s) will need to be reattempted in full, regardless of individual assessment criteria that were passed on any prior attempt. The EPA Report will contain feedback on which areas there are for development along with resit or retake guidance.

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Assessing the multiple-choice examination

The multiple-choice examination will contain 40 knowledge-based questions and have a time limit of **40 minutes**. The pass mark for this exam is **25 out of 40**.

Multiple-choice examination		
Pass	**Merit**	**Distinction**
25-29 marks	30-35 marks	36-40 marks

The apprentice may refer to training material/reference books but may not access computer search engines or similar.

A maximum of 12 apprentices per administrator/invigilator is allowed.

Please refer to the Highfield Examination and Invigilation policy for further information regarding the ID verification process and details regarding the set-up of end-point assessments.

Before the assessment

- While on-programme, the employer/training provider should brief the apprentice on the areas to be assessed by the multiple-choice examination
- In readiness for the end-point assessment, the apprentice should complete a sample examination
- A sample assessment can be found as a separate download on the Highfield Assessment website

Multiple-choice examination criteria

Compliance	
E1	Explain the employers' main duties under the Health and Safety at Work Act
E2	Critically evaluate the customer compliance requirements of the business

Project management	
E3	Clarify the business case through risk analysis and management
E4	Describe the toll-gate review process
E5	Identify the purpose of creating a work breakdown structure
E6	Evaluate the use of benefits tracking in project management
E7	Explain the purpose of process management when managing projects

Change management	
E8	Identify a key benefit of applying the RACI model to managing change
E9	Summarise typical responses to organisational and personal change as outlined in change curve theory
E10	Outline the role of the sponsor in managing change
E11	Explain how the compelling point of view can support organisational change

Principles and methods	
E12	Explain the business value of Six Sigma methodology
E13	Evaluate the importance of DMAIC phases in Lean Six Sigma problem solving
E14	Summarise the purpose of the 8D approach to problem-solving
E15	Explain the main principles and business value of Lean

Project selection and scope	
E16	Interpret the use of Y=f(x) equation in determining project selection
E17	Explain the benefits of cascading the balanced scorecard through the business through teams, and to individuals.

Problem definition	
E18	Define the meaning of cost of poor quality
E19	Evaluate different problem analysis models, for example, Is/Is Not

Process mapping and analysis	
E20	Explain the purpose of 'swim lanes' in flow diagrams
E21	Identify the objectives of value stream mapping
E22	Summarise the information shown in a Parameter Diagram
E23	Explain how Takt time is calculated
E24	Identify the three factors in Overall Equipment Effectiveness
E25	Evaluate the Theory of Constraints methodology in analysing processes
E26	Explain the use of the Kanban system in the manufacturing process

Data analysis
E27 Explain the importance of spreadsheets and pivot table analysis **E28** Evaluate different statistical analysis software

Measurement systems
E29 Define the difference between repeatability and reproducibility when appraising measurement systems

Basic statistics and measures
E30 Explain the outputs of a control chart

Data analysis - statistical methods
E31 Identify the three main measures of central tendency **E32** Evaluate the relationship between the measure of spread and the measure of central tendency in data analysis

Process capability and performance
E33 Explain the purpose of a process-capability analysis **E34** Explain why continuous data is used in capability analysis

Root cause analysis
E35 Explain the difference between failure mode, failure cause and failure effect **E36** Explain the objective of verifying potential root causes of a problem **E37** Evaluate the importance of understanding the critical inputs of a process **E38** Define the term 'escape point' in a control system **E39** Identify the advantages of visually representing data in graphical form

Experimentation
E40 Explain the difference between active and passive analytics **E41** Describe the purpose of design of experiments **E42** Evaluate the purpose of designing an experiment plan

Identification and prioritisation
E43 Identify factors to consider when selecting improvement projects **E44** Summarise the purpose of Failure Mode and Effects Analysis

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Assessing the project report, presentation and questioning

During the 14-18 months leading up to the EPA, the apprentice should have been working on improvement projects and as such, should have produced a project portfolio that details the projects they have been part of.

The project portfolio will then be used by the apprentice to assist them in writing and producing a project report about the improvement project(s) they have been involved with.

The project report is to be submitted to Highfield by the apprentice within 1 month following gateway.

The improvement project **must**:

- clearly demonstrate delivery of a business improvement benefit
- be authorised with a signed statement from the line manager to confirm the project's authenticity and business benefit
- follow each step of 1 of the recognised improvement methodologies
- have been completed in the apprentice's workplace
- address a fundamental business problem

Project brief

The apprentice should be involved in a substantive improvement project that allows them to meet the assessment criteria assigned to this assessment component. The project should involve collaborating with others to identify and analyse failure modes, for example, the way the failure occurs and its impact. From this, the apprentice should generate appropriate corrective actions for reducing the occurrence of failure modes or improving their detection and continue to work with others to determine the effectiveness of the corrective actions taken.

The project should be suitably planned, in accordance with the sector statutory regulations and organisational policies and controls regarding decision-making, finance and legal compliance. A project plan should be developed, as should a project charter, based on initial analysis and lessons learnt to meet the project deliverables.

The apprentice should select and make use of recognised tools and models to obtain and use data and information, and make use of appropriate techniques (failure mode, effects analysis, affinity grouping and selection and prioritisation matrix) to identify and prioritise factors, ideas and solutions.

The project should demonstrate the application of appropriate lean techniques (for example, 5S, standard work, Kaizen, error proofing tools and value stream mapping) to analyse processes and their value to the customer and identify and categorise waste in the process.

The apprentice should prepare for, plan and run a controlled analysis to check the repeatability/reproducibility, and analyse the results of the study and determine the root cause of any problems. There should be clear demonstration of data-backed decision-making to support experimentation and optimisation.

This assessment component is made up of **3** parts:

1. **Project report**

The project report must be produced during the end-point assessment period and submitted to Highfield **within 1 month** of the gateway meeting, detailing a substantive improvement project they were part of during the on-programme time, which will be confirmed in writing by their employer. The end-point assessor will read the project report prior to the presentation and questioning.

The report **must** follow each step of 1 of the recognised problem-solving methodologies, for example, 'Define, Measure, Analyse, Improve, Control' (DMAIC), '8 Disciples' (8D), 'Practical Problem Solving', etc.

The report should:

- be a concise, visual summary
- follow the principles of 'A3 Thinking'
- convey key points in a way that enables messages to be grasped 'within 3 seconds'
- be typically 1 to 3 sides of A3
- include any support documents in an annexe, which **must** be submitted with the report, and which **must** be distinct from documents included in the project portfolio

The apprentice should clearly explain:

- the reasons for project selection
- how each improvement tool was used
- the business benefit of the project including a key performance indicator measure (for example, hours saved or money saved)
- how the apprentice worked with a team of people during this project

The project report **must** be authorised by the means of a signed authenticity document from the apprentice's line manager to confirm authenticity and business benefit.

The written submission sheet that is available to download on the Highfield website **must** be completed and signed by the apprentice and the employer. This submission sheet must accompany the project report when it is submitted. The assessment component cannot proceed without the written submission sheet being signed.

2. Presentation

The apprentice will have to produce a presentation based on the project report and deliver this to the end-point assessor who will then be able to question the apprentice based upon the information contained in the presentation.

There is no word or content restriction in the presentation but, it must follow each step of 1 of the recognised problem-solving methodologies.

The presentation **must** also be authorised by means of a signature from the apprentice's line manager confirming authenticity and business benefit.

The presentation must last for **no more than 40 minutes**.

A representative of the apprentice's employer must be present during the presentation but only for the purpose of confirming the validity of the information provided in the question-and-answer section, providing guidance to the assessor in terms of employer policy and practice where requested and to create a realistic presentation environment. The employer must not amplify or clarify points made by the apprentice. Internal or external quality assurance staff may also be present.

The assessment component **cannot** proceed if a representative of the employer is not present.

Presentation format

It is up to the apprentice how this information is presented. It can be presented in any format. Acceptable forms of presenting include:

- slide presentation
- a large copy of the project 'A3' report
- images
- charts

3. Questioning

The apprentice **must** bring their project portfolio of evidence and all necessary materials to the presentation and questioning. If the apprentice does not bring their project portfolio of evidence to the questioning element of this assessment, then the assessment would need to be rescheduled.

For each of the required criteria that are not naturally evidenced through the report and presentation, the end-point assessor will need to ask follow-up questions to elicit evidence that the criteria have been attained. The questioning will last for **no more than 35 minutes**.

Example questions:

- team formation and leadership
    - How would you lead a cross-functional team undertaking an improvement project?
- coaching
    - How have you coached colleagues to apply improvement tools?
- change management
    - Tell me about possible barriers to change and how Force Field analysis affects this.

Before the assessment

- The apprentice must complete a project report based on the improvement project they have been a part of during their time on-programme
- The project report must be submitted to Highfield Assessment within 1 month following the gateway meeting. The presentation will take place within month 2 and the apprentice will be given a minimum of **2 weeks'** notice of when the presentation will be.
- The apprentice must create a presentation around the content contained in the project report
- Employers/training providers should discuss any relevant improvement projects that have been implemented within the business over the on-programme duration that the apprentice has been present

Employers/training providers should:

- ensure the apprentice knows the date, time and location of the end-point assessment
- encourage the apprentice to reflect on their experience and learning on-programme to understand what is required to meet the standard
- inform Highfield of the apprentice's selected method of presentation
- prepare/check any/all equipment necessary to enable to apprentice to present

Project report, presentation and questioning mock assessment

It is the employer/training provider's responsibility to prepare apprentices for their end-point assessment, and Highfield recommends that the apprentice completes a mock presentation and experiences the mock questioning in preparation for the real thing. The most appropriate form of mock assessment will depend on the resources available and the industry the apprentice has been working on improvement projects on. The apprentice should be encouraged to practise their improvement project presentation with the employer/training provider before the end-point assessment.

In designing a mock assessment, the employer/training provider should consider the following elements in its planning:

- the subject of the mock presentation should be a real improvement project that the apprentice has been a part of.
- the report must show a clear business benefit to the employer.
- the presentation can be in any format but must be a concise visual summary.
- the key points of the presentation must be grasped within 3 seconds.
- apprentices must clearly explain the reasons why they chose the selected project, how each improvement tool was used, the business benefit of the project including a key performance indicator measure (hours saved, money saved, efficiency increase) and how the apprentice worked with a team of people during the project.
- the project must follow 1 of the recognised problem-solving methodologies.
- a **75-minute** time slot should be made available for the complete presentation and questioning (maximum of **40 minutes** for the presentation and maximum of **35 minutes** for questioning) if it is intended to be a complete mock observation covering all relevant standards. However, this time may be split up to allow for progressive learning.
- consider a video recording of the mock assessment, and allow it to be observed by other apprentices, especially if it is not practicable for the employer/training provider to carry out a separate mock assessment with each apprentice.
- ensure that the apprentice's performance is assessed by a competent trainer/assessor, and that feedback is shared with the apprentice to complete the learning experience. The mock assessment sheets found on the Highfield Assessment website can be used for this purpose.

Project report, presentation and questioning criteria

The presentation and questioning will last for a total of **75 minutes**, during which the following standards should be evidenced. Apprentices should prepare for this by ensuring their project report covers the criteria below and that they can speak comfortably for up to **40 minutes** about this in the presentation.

Project report, presentation and questioning	
To pass, the following must be evidenced	
PR1	Show business benefit to the apprentice's employer (S22)
PR2	Follow the steps of a recognised problem-solving methodology (e.g. PPS, DMAIC, 8D) with a clear flow from one step to another and supported by the application/interpretation of appropriate Lean, Six Sigma, project management and change management tools (S1, S4, S5, S6, S7, S8, S9, S10, S11, S19, S22)
PR3	Demonstrate data-backed decision making to support definition, measurement, analysis and improvement (S12, S13, S14, S15, S16, S17, S18, S20)
PR4	Explanation of how they chose and scoped the project (S7)
PR5	How they used each tool (S6)
PR6	How they led a cross-functional team during the project (K2, K4)
PR7	How they coached colleagues in the application of improvement tools (S3)
To gain a merit, the following must be evidenced	
PR8	Clearly explains how the outputs of each tool are used to inform the next step (S7, S8, S9, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S22)
PR9	Identifies and takes the opportunity to share and/or replicate the improvements made to one other area/system, where there are differences in the solutions/controls required to deliver successful outcomes (B1)
To gain a distinction, the following must be evidenced	
PR10	*Identify and take the opportunity to share and/or replicate the improvements made to one other area/system, where there are differences in baseline metrics (B1)*
PR11	*Seeks opportunities to apply Lean, Six Sigma, project and change management tools in daily work (B4)*

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Assessing the professional discussion underpinned by log

The apprentice must complete a log that details all of the training, learning and workshops they have attended. This log will be completed during the on-programme part of the apprenticeship.

The log **must** be submitted to Highfield at gateway. The log is reviewed by the end-point assessor before the professional discussion takes place.

The apprentice must bring a copy of their log to the professional discussion to show the assessor extracts if necessary.

The assessment component **cannot** proceed if the apprentice does not bring their log to the discussion.

The evidence produced is mapped holistically so that 1 piece of evidence may cover more than 1 standard set for the professional discussion.

The log will typically reference between 13 and 15 pieces of evidence. The log will then be used as the focal point of the professional discussion and as such will not be assessed in itself as a separate assessment method.

The independent assessor will ask the apprentice between 13 and 15 open questions relating to the log and can if deemed necessary, ask further follow-up questions for clarification to elicit evidence that all the required standards have been attained.

The apprentice will be asked, with reference to their log, to explain how the criteria set out below were practically achieved.

Example open questions that might be used could include:

- describe your role in the improvement team.
- give me an example of where best practice was shared with others.
- what was the objective of working independently?
- how did you identify own your strengths and areas for improvement?

The professional discussion must **not** last any longer than **60 minutes.**

A representative of the apprentice's employer must be present during the presentation but only for the purpose of confirming the validity of the information provided in the question-and-answer section, providing guidance to the assessor in terms of employer policy and practice where requested. The employer must not amplify or clarify points made by the apprentice. Internal or external quality assurance staff may also be present.

The assessment component **cannot** proceed if a representative of the employer is not present.

Before the assessment

The log must be submitted to Highfield at the gateway meeting and will be reviewed, but not assessed, by the end-point assessor before the professional discussion.

Employers/training providers should ensure:

- the availability of quiet and private rooms suitable for all of the end-point assessments to take place with chairs and a standard or larger sized desk available for each apprentice
- that appropriate reasonable adjustments are made with Highfield if an apprentice is declared to the employer as having special needs
- that the apprentice is encouraged to reflect upon their experiences from their on-programme time and how this is relevant to the criteria
- the apprentice is aware of the date/time and location of the assessment
- the apprentice knows which assessment criteria they will be assessed on

It is suggested that a mock assessment is carried out by the apprentice in advance of the end-point assessment with the training provider/employer giving feedback on any areas for improvement.

Professional discussion underpinned by log mock assessment

It is the employer/training provider's responsibility to prepare apprentices for their end-point assessment, and Highfield recommends that the apprentice completes a mock professional discussion in preparation for the real thing. The most appropriate form of mock assessment will depend on the resources available and the industry the apprentice has been working on improvement projects.

When planning a mock assessment, the employer/training provider should include the following elements:

- a 60-minute time slot must be made available for the professional discussion.
- make sure the mock professional discussion takes place in a suitable location.
- consider audio or video recording of the mock professional discussion and allow it to be available to other apprentices, especially if it is not practicable for the employer/training provider to carry out a separate mock assessment with each apprentice.
- ensure that the apprentice's performance is assessed by a competent trainer/assessor and that feedback is shared with the apprentice to complete the learning experience. The mock assessment sheets found on the Highfield Assessment website can be used for this purpose.

The employer/training provider can ask up to 15 open questions and can ask follow-up questions if necessary, for clarification to elicit evidence that the criteria have been attained.

The apprentice must be asked open questions with reference to their log to explain how the criteria have been achieved. For example:

- explain what methods you used to help you make decisions in the team.
- what did you consider in the creation and subsequent review of the project charter?
- what approach did you make use of when managing the project?
- in what ways does your project management differ to that of your colleagues?
- how did benchmarking provide you with improvement options?
- why was the benchmarking process important in target setting?
- how did benchmarking help you?

The apprentice will discuss and present the evidence of their training, learning and workshops undertaken.

The log should:

- clearly demonstrate the completion of any training, learning and workshops attended
- ensure that there is a minimum of 1 piece of evidence for each required criterion

Professional discussion underpinned by log criteria

During the professional discussion, which will last for **60 minutes**, the following standards should be evidenced. Apprentices should prepare for the professional discussion by considering how the criteria can be met and by reviewing the evidence contained within their log.

Professional discussion underpinned by log	
To pass, the following must be evidenced	
PD1	Continuously drives for change and encourages others to deliver results across functional areas and standardises best practice (B1)
PD2	Demonstrate awareness of their own and others' working styles to create a high performing team (B2)
PD3	Promote a moral, legal and socially appropriate working manner, aligned to the organisation's values and maintains flexibility to the needs of the project (B3)
PD4	Critically evaluates own improvement journey and identifies the recommendations for improvement/change (e.g. "If I were to do this again I would…") (B4)
PD5	Proactively seeks and acts on feedback. Reflects on performance and demonstrate the desire for development. Adapts quickly to working with new situations, stakeholders and challenges (B4)
PD6	Ensures the safety of themself and others and speaks out to challenge safety issues (B5)
PD7	Clearly explains methods used for making decisions in the project team (K2)
PD8	Clearly explains how they engaged and influenced others (S2)
PD9	Clearly explains their coaching skills by observing, listening, using questioning, providing feedback and spotting learning opportunities (S3)
PD10	Clearly explains their approach to Project Management (S4)
PD11	Clearly explains their approach to Change Management (S5)
PD12	Designs an experiment with clear objectives. Conducts a measurement system analysis to ensure the integrity of data collected under the experiment. Analyses the results of the experiment data to identify opportunities to optimise processes or improve products (S18)
PD13	Clearly explains their use of benchmarking to inform target setting and improvement options (S21)
To gain a merit, the following must be evidenced	
PD14	Identifies opportunities for cross-functional improvement (B1)
PD15	Supports delivery of business-wide improvement projects led by improvement experts (B4)

To gain a distinction, the following must be evidenced	
PD16	*Takes the opportunity to prepare and/or deliver training to upskill colleagues (B1)*
PD17	*Seeks opportunities to involve others in building a continuous improvement culture (B4)*

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