Department for
Business, Energy
& Industrial Strategy

Translational Energy Research Centre

Operations Strategy

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Executive Summary

The Translational Energy Research Centre (TERC) and Sustainable Aviation Fuel Innovation Centre (SAF-IC) both provide the infrastructure and expertise for research, development and innovation (RD&I) in sustainable energy technologies, with the aim to boost cooperation between research institutes as well as expediting the commercialisation and use of these new technologies by commercial and industrial businesses, including suppliers.

The success of the centres depends on the effective management of its operations, as well as other aspects of an enterprise, such as business development and financial management. This document concentrates on the operations strategy of the centres.

The operations strategy is divided into 3 parts, namely: asset integrity, which oversees the optimal performance of assets from specification through to disposal; resource management, which manages the research programme as well as planning and scheduling research work on the different assets; and quality, health, safety and the environment to ensure the work is of the highest standards of quality and with minimal risk of harm to people or the environment.

The strategy will be implemented according to the Plan-Do-Check-Act cycle, after Deming, and so the approach to support activities, such as risk management, communications plan, key performance indicators, monitoring and review are also included.

Introduction

This report focuses on the operations strategy for the University of Sheffield's Translational Energy Research Centre. A brief background of the centre is first given as a contextual reference.

Background

The Translational Energy Research Centre (TERC) provides the infrastructure and expertise for research, development and innovation (RD&I) in low carbon, renewable energy generation technologies, processes and systems, and aims to boost cooperation between research institutes as well as increasing the uptake and installation of renewable energy systems among commercial and industrial businesses, including energy suppliers.

The Sustainable Aviation Fuel Innovation Centre (SAF-IC) provides state-of-the-art facilities to test, certify, and deploy sustainable aviation fuels in accordance with ASTM (American Society for Testing and Materials) standards.

These facilities offer a comprehensive range of flexible and compatible state-of-the-art equipment to enable research into some of the most pressing energy challenges and aligned with the priorities of the Clean Growth Strategy of the Government of the UK, South Yorkshire Mayoral Combined Authority's (SYMCA) as well as those of the Intergovernmental Panel on Climate Change (IPCC).

Through this offer and by working with regional, national and global companies, focussed RD&I in new technologies will lead to more rapid commercialisation.

The facilities will be open access and support industrial and academic RD&I through collaborative or contract projects, in line with State Aid rules, for different types of projects. Most projects will be publicly funded collaborative industrial-academic projects with a small proportion (limited to 20% by its public research organisation status) of contract research and services.

Further, through alignment with University of Sheffield strategy and policy, the facilities will be world-leading, striving for research excellence through:

- Quality of research outputs, such as datasets, journal articles and conference proceedings.
- Impact of research to society locally, regionally, nationally and globally.
- Quality of the research environment, such as facilities, resources and staff.

The success of the facilities in delivering these goals is dependent in part on these "success factors":

- Asset integrity.
- Resource management.
- Quality, health, safety and environmental management.
- Marketing and communications.
- Business development and engagement.
- Human resource.
- Financial sustainability.

The remainder of this strategy document focusses on asset integrity, resource management, and quality, health, safety and environmental management, while separate strategy documents cover the remaining factors. Nonetheless, it must be borne in mind that none are mutually exclusive.

The strategy is generally based on continual improvement using lean thinking principles and a positive workplace culture. The foundation for this will follow from the University’s values:

- Mutual trust and respect.
- Open communications.
- Collaborative working.
- Striving for excellence.

To aid understanding of this strategy and identify the key internal stakeholders within the Centres, an organisation chart is provided in Appendix 1.

Operations Strategy

The operations strategy is divided into three parts, comprising asset integrity, resource management and quality, health, safety and the environment. In addition, there are support activities, such as communications plan, risk management, key performance indicators, monitoring and review.

Asset Integrity

The objective of asset integrity management is to ensure equipment performs its required function effectively and efficiently whilst protecting health, safety and the environment throughout its life cycle.

To deliver the strategy, we will:

- Manage centrally the acquisition, operations, maintenance and disposal of research equipment.

- Plan service-related and maintenance activities to keep equipment safe, reliable and available.
- Ensure a consistent approach to lifecycle management based on risk.
- Improve cost efficiency and control throughout an asset's life.

A clear set of principles and a framework (Figure 1) within which the assets will be managed is required.

Generally, the direction for the equipment employed will be set by the resource strategy, which will be derived from the business strategy, research programme and the competences of the organisation and its people, and the existing equipment capability.

Throughout an asset's life cycle, ensuring compliance with legislation, managing risk and assuring quality will be through continual assessment, monitoring and review, including specific methods such as process hazard analysis (PHA), hazard identification (HAZID) and hazard and operability (HAZOP) studies, and management of change (MoC).

Process safety studies, such as PHA, HAZID and HAZOP, will be led by specialist consultants to ensure independence and thoroughness.

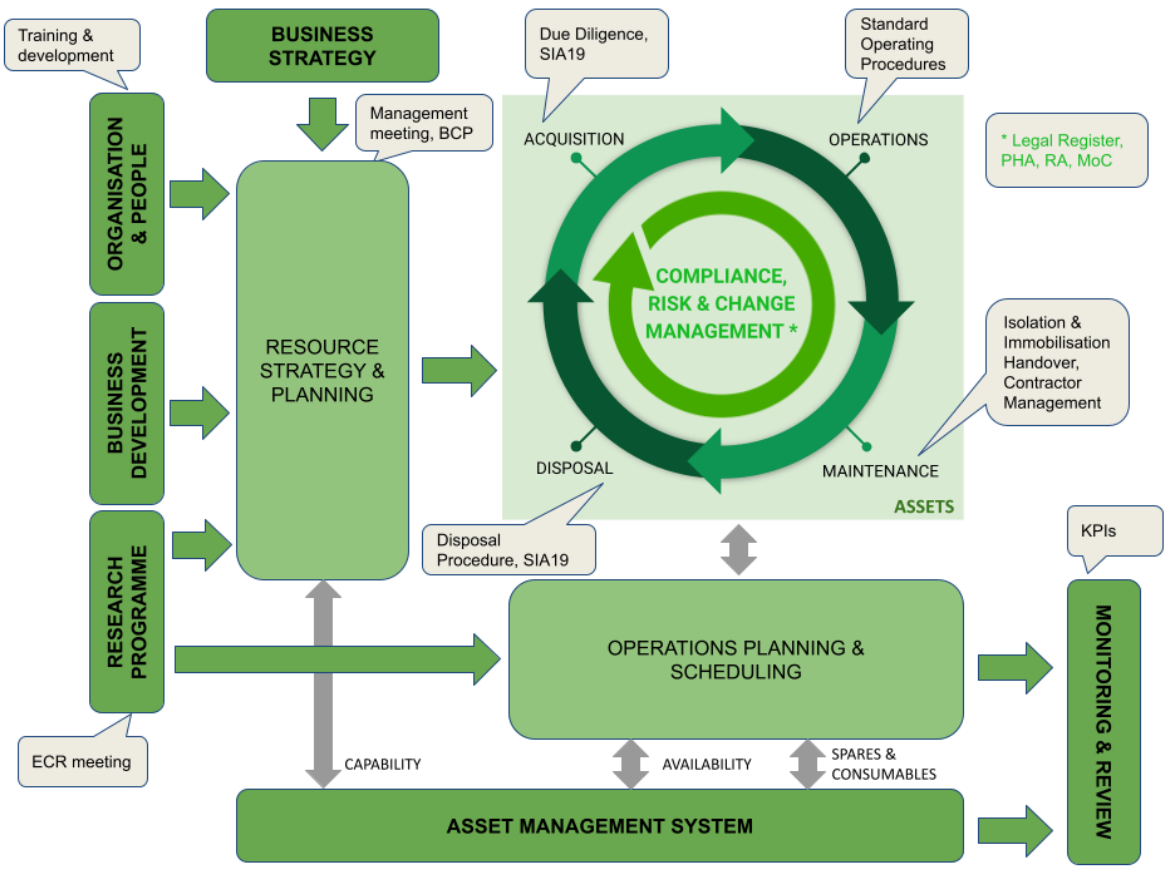
Management of change will be given special consideration owing to inadequate management of changes to processes and equipment, whether they are temporary or permanent, being the root cause of many industrial accidents. As well as identifying the systems for which management of change processes must be followed, training will be provided to personnel to ensure they understand what constitutes a change, that the change is suitably risk assessed by people having the competence to do so and then authorised by management (at a level consistent with the risk presented to the business). The effectiveness of the change and the process of its management will also be reviewed.

The distinct phases of an asset's life cycle will be supported by existing or new processes and procedures:

- Acquisition
  Financial and commercial control will be assured by following the existing Financial Regulations Supplementary Information Advice notes "SIA16 - Procurement and Tendering" and "SIA19 - Property, Leases, Rates and Equipment", while suitability and safety of the equipment will be assured by further due diligence, such as pre-purchase assessment of the equipment including, for example, design conformity (e.g. UKCA product marking) and compliance with Provision and Use of Work Equipment Regulations (PUWER) 1998.
- Operations
  Operational tasks will have risk assessments (RAs) completed and, where necessary, standard operating procedures (SOPs) prepared that include setting-up, basic maintenance tasks as well as foreseeable abnormal or emergency situations. The basic maintenance tasks would ensure its continuing, correct operation without the need for a specialist technician (in Total Productive Maintenance (TPM) parlance, this is autonomous maintenance).

- Maintenance
  Systems will be in place for the hand-over of equipment between operational and maintenance phases, such as permits to work. There will be additional procedures for isolation and immobilisation of equipment, such as “lock-out tag-out”, and for contractor management, the latter including pre-qualification questionnaires, risk assessments and method statements, permits and post-completion reviews.
- Disposal
  As with the acquisition of equipment, financial and commercial control will be assured by following SIA19 and further due diligence will ensure compliance with health, safety and environmental legislation, such as the Waste Electrical and Electronic Equipment (WEEE) Regulations 2013 and The Hazardous Waste (England and Wales) Regulations 2005, with aspects of this already being managed by the University’s Estates and Facilities Management function.

Figure 1: Asset management model



The maintenance of the assets will be planned and scheduled by evaluating and balancing the research programme, resources (see “Resource Management” section) and maintenance needs, including statutory examinations. The effectiveness of this activity will be monitored, using key performance indicators (see “Key Performance Indicators” section), reviewed and improvements planned as appropriate.

The steps to achieve this framework are:

- Develop a methodology to manage physical assets from the design, procurement and installation of equipment, through operation and maintenance to decommissioning and disposal.
    - Initiate and maintain an inventory for the equipment, including a durable asset marking system and a nomenclature with sufficient granularity to identify the asset's sub-assemblies as appropriate.
    - Detail any existing procedures to be followed during the life cycle stages and develop new procedures where existing ones are inadequate or absent.
- Develop a methodology to plan, schedule and execute operations and maintenance activities.
    - Identify and assess the maintenance (including calibration) requirements for equipment including the competence of personnel undertaking the work and required critical spares and consumables. Where competence is inadequate, the need to develop or recruit employees, or to contract out the work, will be appraised.
    - Identify statutory inspection and examination requirements for equipment that are undertaken by the University's Estates and Facilities Management function and ensure the schedules and records are visible to the users of the equipment.
    - Implement a system for the hand over and hand back of equipment between operations and maintenance activities, whether the maintenance is being undertaken by employees or contractors.
    - Develop a repository of information regarding the capacity (e.g., throughput), operating and maintenance costs, operating constraints and interdependencies of assets to assist with the planning, scheduling and monitoring of asset utilisation.
- Procure a computerised maintenance management system (CMMS), or similar, to manage the asset and spares inventory, planned preventative maintenance (PPM) programme, technician assignment and service records.

Resource Management

The objective is to organise and coordinate the operation of equipment to deliver efficiently and effectively the required project outcome on time, on budget and to the expected quality.

To deliver the strategy, we will:

- Develop a more unified approach to managing the research programme and new work arising from business development activities and grant funding applications.

There are two significant threats to the success of the business:

- Operations are often unaware of the individual research projects, which are progressed from grant application stage through to execution by the academics, until there is a need, sometimes immediate, for materials or technical resources to undertake work.
- Failure to balance work, assets and resources, especially as assets and resources are constrained, e.g., assets have a finite capacity, and the workforce is necessarily highly skilled and competences often unique to an individual.

Thus, resource planning must change from a situation where:

- Researchers have unfettered access to assets to one where there is defined access according to a prioritised work programme.
- Work activities are independently managed to one where they are part of the whole operation with inter-dependencies and conflicts properly managed.

In addition to ensuring the availability of resources and delivery of the work, the project management process must also continually review the validity of the business case, risks and the quality of the deliverables for the project.

The operations management process must consider and balance the requirements of the research programme, asset capacity, capability and availability, constraints and dependencies, costs, competence and availability of workers, availability of raw materials (Figure 2). Further, operational or physical changes to the assets may be required and, in some cases, could involve significant design and build changes, which must be planned but also controlled through a management of change process (see “Asset Integrity” section).

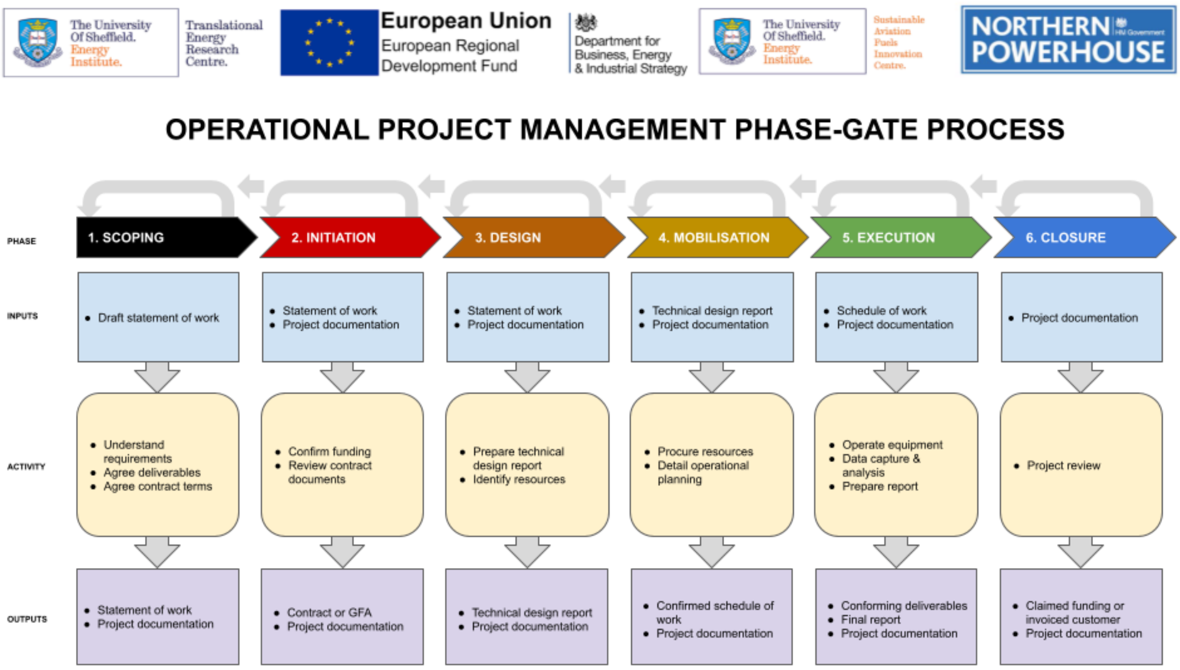
The steps to achieve this are:

- Establish a flexible, phase-gate process for project management (Figure 3) for RD&I work, whether this is funded by research grants or private contracts, from scoping of the work through to its completion. This process will require two main components:
- A procedure, including checklists and forms, for ensuring that necessary information for the feasibility and success of the project is available for consideration and communicated to relevant parties.
- A project board comprising key internal stakeholders to authorise, monitor and control the project’s progression through its life cycle.

Figure 2: Resource management model

The process is based on the waterfall lifecycle and adopts elements of an approach used elsewhere in the University of Sheffield and the PRINCE2 methodology. This ensures that risks are properly managed, essential information is communicated and quality of the work considered throughout the project.

Figure 3: Project Management Phase-Gate Process



Implement a research programme and operations management process to plan, execute, monitor and review work activities and associated performance criteria. This process will involve a framework of meetings to consider work activities over different timescales, for example:

- Biannual “research programme” meeting to review pre-award grant applications, pipeline and funded projects and business development opportunities, to forecast requirements of assets and resources. This will involve the operations manager, business development manager, senior technical fellow, head of commercial and finance, and communications and marketing officer.
- Monthly meetings to focus on the research projects over the next few months, reviewing their achievements and challenges, and project and resource plans, thereby refining forecasts of asset and resource requirements. This will involve the researchers and operations manager, but the remit of an existing fortnightly technical meeting could be broadened and involve more participants.
- Weekly meetings to prioritise and plan work for the next two or more weeks, involving operations manager, senior technical fellow and technical team leader. The focus being health and safety concerns or items for communication, matters impeding progress on early work activities, understanding new work requests and prioritising and scheduling the activities for the next few weeks.
- Daily meeting involving technical team leader, senior technical fellow and capital projects manager to share any lessons learned from earlier tasks, matters impeding progress, health and safety issues and establish priority tasks for the day.

Quality, Health, Safety and Environment Management

The objective is to develop the organisation’s culture as well as ensuring compliance with legislation and the University of Sheffield’s requirements and ensure equipment can operate consistently and to the highest standards, thereby contributing to RD&I outcomes with high veracity.

To deliver the strategy, we will:

- Ensure compliance with legislation and University requirements by integrating well-established processes with newly developed, business-specific ones into our management system, and adopting and developing best practices.
- Cultivate strong teamwork with a common purpose of continually improving the quality of our enterprise, health, safety and wellbeing of our people and the sustainability of our operations.
- Continually monitor, review and improve processes and procedures to ensure overall improving performance.

Quality

The quality of deliverables (Figure 4) depends chiefly on the clients’ requirements being understood and aligned with our strategy, capability and ability and this will be assured by having open, collaborative relationships with customers, funding authorities and suppliers as well as ensuring our operational and research activities have intrinsic quality controls.

The relationship between contract customers or public funding providers and us will be managed during business development and will utilise existing University processes to ensure compliance with legislation and the funding agreements, as well as ensuring the quality of activities, outputs and impacts.

Client relationships will be managed through existing processes, but quality assurance will require specific processes to be developed, covering initial scoping discussions through to delivery of the service (see also "Resource Management" section).

Similarly, the capability of employees will be maintained and developed through existing human resource procedures, such as the annual Staff Review and Development Scheme (SRDS) and other development opportunities.

The quality of equipment will be assured through its lifecycle and will be an intrinsic part of asset integrity management (see "Asset Integrity" section).

Where our operations are supported by, or dependent on, third parties, the vendors will be required to hold a recognised quality management certificate, or similar quality management processes and procedures; for the latter, third party audits of the vendor may be undertaken.

Where standard operating procedures are developed, critical points for ensuring risks to quality, as well as health, safety and the environment, will be identified, the risks evaluated, and appropriate control measures implemented.

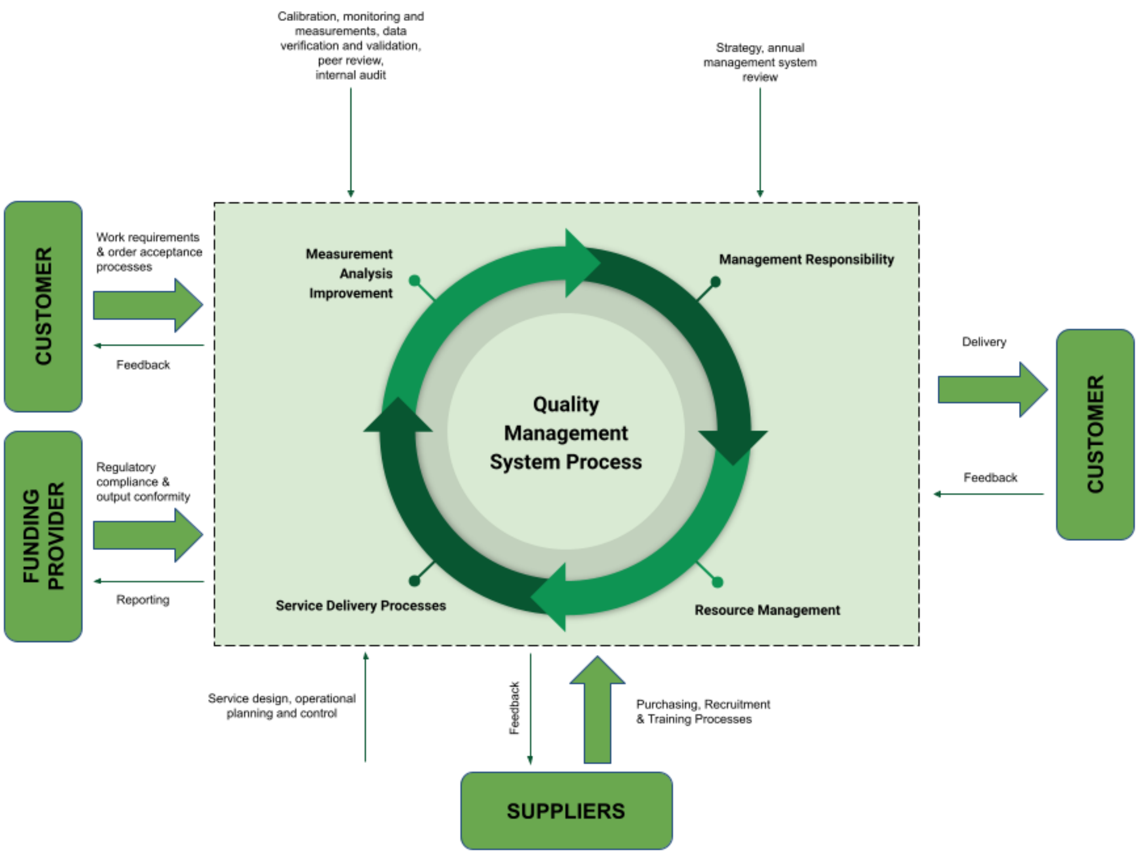
The quality of research work and reports will be assured through existing practice:

- the use of data management plans, which allow researchers to organise data, keep it safe, ensure and restrict access to those who need it as well as highlighting data management issues; and
- peer review to validate research work and assure the quality of the published research.

In addition, the new project management system (see "Resource Management" section) will be established to not only assist with the delivery of the research within the constraints of the business and ensure the aforementioned practices are followed but also ensure the project is, and remains, desirable, viable and achievable.

We shall work also to gain ISO 9001 certification for internationally recognised alignment with customers' expectations.

Figure 4: Quality Management System Process



Safety, Health and the Environment

In addition to fulfilling the University's requirements and legal compliance, we shall work to gain certifications for ISO 45001 and ISO 14001, so that we are aligned with the expectations of industrial partners.

Process safety, as well as mitigating harm to people and the environment, is fundamental in the way we operate, and we shall through the University's procurement system and our own contractor management processes ensure that suppliers and contractors comply with their obligations under current legislation and the University's requirements.

The safety of our plant and people requires robust management processes, including:

- Preparing an annual plan of aspects that require improvement or need to be implemented, which will be based on, but not limited to, a review of performance and changes in legislation and operations, which will then be implemented and monitored through the year.
- Hazard identification as the starting point for risk management of our activities, including procuring specialist, independent advice for process safety related studies, such as hazard identification and operability.

- Risk management, including risk evaluation and implementation of risk reduction measures according to the hierarchy of control for both asset integrity (from the design and build stages of asset procurement through to disposal) and operational control, whether these are research, or maintenance or repair activities.
- Emergency planning will identify and make arrangements to protect people, visitors, contractors and the public, our assets, the environment and our reputation in the event of an incident, such as fire or an uncontrolled release of gas. The fire arrangements will be made in collaboration with the University's fire officer and other emergency arrangements in response to hazard identification studies, etc.
- Contractor management, including pre-qualification of vendors, induction training and the use of risk assessments and method statements and permits to authorise work, including special permits, such as for hot work or working at height.
- Operational control of our own activities, for example, ensuring equipment is suitable and maintained in good working order, using permits to work to control handover of equipment and standard operating procedures for safe and consistent operation of equipment.
- Management of change will be required whenever changes to plant, process, procedures or the organisation could invalidate risk control measures and potentially lead to harm.
- Competence of employees will be ensured through training needs analysis, carried out at least annually at the Staff Review and Development Scheme appraisal and at phase-gates during the project. Contractor competence will be assessed during pre-qualification questionnaires and checks of individuals prior to work being carried out.
- Incident reporting and investigation, following the university's "accident and incident reporting" protocol, will ensure thorough documentation and analysis of the incident and identification of the root causes, so that lessons may be learned and shared to prevent their recurrence. Incidents will be considered to comprise injury and non-injury accidents, but also near misses and unsafe conditions to maximise the learning opportunities.
- Open, bidirectional communication will be fostered through multiple channels with employees, suppliers and visitors. Internally, this will ensure the sharing of concerns and lessons learned, for example: a monthly health and safety meeting; daily and weekly operations meetings will include toolbox talks; safety tours will facilitate open dialogue with employees, contractors and visitors about health and safety matters; and health and safety campaigns will be communicated via multimedia on topics that require specific focus, such as slips, trips and falls. Externally, the importance of health and safety will be conveyed to suppliers and customers, through pre-qualification questionnaires, risk assessments and method statements and reviews of performance.
- Performance monitoring of leading or proactive and lagging or reactive indicators will both permit progress, such as implementation of the health and safety plan, and developing issues, such as near misses, to be tracked and appropriate, effective improvement action taken. Further details of performance indicators are given below (see "Key Performance Indicators" section). These indicators will be reported to senior management on a monthly basis.

- Audits will include horizontal audits of a specific topic across several teams or projects and vertical audits through multiple processes in one team or on one project to assess the efficiency, effectiveness and reliability of the management system and facilitate planning for improvement action. Results from audits, and other surveillance processes, will be reported to senior management and a formal annual review undertaken to assess performance, identify areas for improvement and prepare the annual plan.

In addition, we shall encourage our suppliers to hold or be working towards having a recognised environmental management system, such as ISO 14001.

The steps to achieve this are:

- Establish a legal register and process to identify, assess and take appropriate actions to ensure continuous compliance.
- Prepare and maintain our integrated management system, for health, safety, quality and the environment, and progress through the assessment stages to certification, and future continuous certification against the relevant ISO standards.
- Deliver IOSH Managing Safely to line managers within the support and academic functions to develop their understanding of health and safety in the workplace, to apply this understanding with confidence and enthusiasm to improve the safety awareness culture and overall performance.
- Promote the use of point of work risk assessments as a tool to augment job specific risk assessments and their associated safety measures to identify and control unsafe conditions and behaviours that may have developed or were unforeseen.
- Provide training to all employees in (behavioural) safety conversations and, through the leadership team, encourage participation and provide support to employees to become comfortable and confident in intervening and speaking with others about their safety concerns and behaviours.

Standards

The Translational Energy Research Centre will work towards implementing an integrated management system that assists in meeting the needs of our customers and employees as well as statutory and regulatory requirements, namely:

- BS EN IS0 9001:2015 Quality Management Systems
- BS EN ISO 14001:2015 Environmental Management Systems
- BS EN ISO 45001:2018 Occupational Health & Safety Management Systems
- BS EN ISO 50001:2018 Energy Management Systems

The pursuit of these certifications may, depending on resources, be incremental rather than all concurrently. In this case, focus will be on achieving certifications in the following descending order of priority: occupational health and safety management systems, quality management system certification, environmental management systems and energy management systems.

In addition to these standards providing a proven framework, the certifications will show that our commitment to quality, health, safety, environmental and energy matters is a cornerstone of our operation.

Key Performance Indicators

As the facilities progress from the latter stages of a construction phase into a fully operational phase, the focus on areas for improvement will change. This section focuses on the likely long-term performance indicators for the business, but in the short-term different performance indicators will be utilised. For example:

For health and safety:

- Number of near miss reports will measure the effectiveness of encouraging employees to report unsafe situations and behaviours and near misses.
- Number of dynamic risk assessments completed will measure that the technical team and researchers are completing risk assessments at the point of work, before commencing work.

For resource planning:

- Number of project plans will measure the effectiveness of the processes to ensure researchers submit plans and resource requirements.
- Number of formal work requests will measure that researchers are providing detailed requirements for work to be undertaken on rigs.

For asset management:

- Number of rigs being installed and commissioned will measure the progress in transitioning from the installation of equipment to its operational readiness.
- Number of assets identified and recorded will measure our progress of compiling an inventory of the assets.
- Number of PPM schedules and critical spares lists will measure the progress of preparing maintenance plans for the assets.

The remainder of this section focusses on the medium- to long-term indicators.

Asset Integrity

There are many common metrics available to measure the reliability and performance of assets, including the effectiveness of maintenance, the efficiency and effectiveness with which repairs are carried out and how well assets are utilised.

In the short-term, simple metrics will be used, such as downtime and uptime, where downtime is the amount of time a process is unavailable owing to a breakdown or being maintained, and uptime is the time that the system is available for operations (but not necessarily being utilised). More detailed reporting would be necessary to understand the cause of lengthy downtime, for example, owing to a resource shortage, availability of spares, etc.

Uptime and downtime can be developed further in other metrics, such as:

Mean time between failures (MTBF) measures the availability and reliability of a process and is essentially the arithmetic mean of the uptime of the process before it breaks down and needs to be repaired:

$$MTBF = \frac{\sum \quad (Start\ of\ Down\ Time - Start\ of\ Uptime)}{Number\ of\ Failures}$$

Mean time to repair (MTTR) measures the reliability of equipment and how efficiently the equipment can be repaired - this is affected by availability of spares, specialist tools, competent resource:

$$MTTR = \frac{\sum \quad (Start\ of\ Up\ Time - Start\ of\ Repair)}{Number\ of\ Repairs}$$

Mean time to failure (MTTF) measures the time between non-repairable failures and will more likely be applied to sub-assemblies or components rather than whole assets or processes:

$$MTTF = \frac{\sum \quad (Start\ of\ Down\ Time - Start\ of\ Previous\ Downtime)}{Number\ of\ Failures}$$

Over time, however, our aim will be to adopt fully “overall equipment effectiveness” as an indicator of our performance, but this will require a better understanding of our utilisation and the process capability. Overall equipment effectiveness (OEE) is one of the popular performance indicators used to monitor and control the effectiveness of production processes and is a product of availability, performance and quality:

$$OEE = Availability\ \times Performance\ \times Quality\ x\ 100\ \%$$

Where:

$$Availability = \frac{Actual\ Run\ Time}{Planned\ Run\ Time}$$

$$Performance = \frac{Actual\ Throughput}{Planned\ Throughput}$$

$$Aulaity = \frac{Acceptable\ Outputs}{Total\ Outputs}$$

The availability of equipment is typically affected by planned and unplanned stoppages. Planned stoppages may include activities such as changing equipment settings or refuelling, so there is a motivation to minimise or optimise these processes using lean principle techniques, such as Single-Minute Exchange of Die (SMED). Unplanned processes are most commonly breakdowns and are primarily a measure of the robustness of preventative maintenance planning if the quality of parts is ignored.

Performance is affected deleteriously by short stoppages and slow production. Short stoppages arise typically from changes in the process, for example, after setting up or maintenance, and are best tackled by our researchers being trained in autonomous maintenance, where they have responsibility for basic maintenance tasks instead of waiting for a technician and incurring longer stoppages. Reduced throughput is often a result of incorrect set-up, wear and tear and poor maintenance. Standard operating practices, supervision and training reduce the likelihood of poor set-up and robust maintenance planning, as well as competent employees and contractors, should avoid slow production due to wear and tear and poor maintenance.

Quality is most evidently affected by defective products, that is, outputs that do not conform to the requirements. The two common types of loss are start-up losses, where changes in set-up, whether as a requirement of the work activity or the result of maintenance work, cause the process to produce out-of-tolerance products. Other defects are likely to occur owing to deterioration in the process, such as wear and tear, sensor drift, and contamination of catalysts. Continuous on-line measurements, such as temperature, or continual monitoring of parameters using statistical process control can prevent this or, at the very least, prevent too many defects being produced before remedial action is taken.

The OEE may then be compared with the benchmark, where 100% is perfect, a value greater than 85% is world-class, greater than 60% is typical and below 40% is considered low.

Resource Management

As the resource management processes mature, it is envisaged that the metrics used to monitor performance will evolve. However, several simple metrics are likely to be useful in monitoring and improving the process:

The number of projects at each phase will allow tracking of projects through their lifecycle and identify likely bottlenecks or constraints if too many are at certain stages.

The number of projects rejected (or reworked) at each phase will assist in targeting training and development and refinement of the process to ensure the right information is presented at each stage.

The number of projects delayed through scheduling will assist in identifying issues with resource constraints, scheduling of activities and availability of assets.

Quality, Health, Safety and the Environment

The performance indicators for quality, health, safety and the environment will comprise leading and lagging indicators. The leading indicators will include:

- Number of risk assessments produced (or reviewed) will provide an insight into the level of engagement among employees in ensuring activities are risks assessed.
- Number of new employees, visitors or contractors having safety inductions when compared with the numbers of new employees, visitors and contractors will help to ensure that people are being informed about the risks and control measures that we have in place.
- Number of emergency exercises completed will both ensure compliance with requirements but also ensure opportunities to practise and improve our emergency response.
- Number of health, safety and environmental inspections completed will help to ensure that sufficient inspections are taking place to detect early shortcomings or poor practices in day-to-day operations and these opportunities are used to improve the systems.
- Number of audits completed and reported will help to ensure sufficient audits are completed to identify issues and development opportunities with the management systems.

The lagging indicators will include:

- Number of incidents, which may be sub-categorised as near misses, first aid cases, lost time injuries and reportable injuries, diseases and dangerous occurrences.
- Number of environmental incidents, such as nuisance odours, spillages and complaints.
- Number of complaints regarding quality of work, such as not providing the deliverables on time or to the required quality.

These lagging indicators will be used to monitor the performance of the management system and identify when interventions are required, beyond the preventative or corrective measures that may have been implemented because of the investigations into specific cases.

Risk Management Plan

The risks present for our business are identified, evaluated and managed in a separate risk register, which is reviewed at regular intervals.

The specific risks associated with the implementation of the operation strategy and the management system may be considered as those common risks that affect the whole strategy and others that are specific to the success factors covered in this operation strategy.

The general risk factors include:

- Senior management not being committed, or being seen to be committed, to the implementation and success of the strategy and the associated management systems.

The motivation for this strategy originates from senior management, so this risk is relatively low, but a visible, ongoing commitment to the strategy will have to be maintained.

- A lack of employee engagement would hinder implementation and will be prevented by ensuring the benefits of the strategy and management system are understood and subsequently engaging with employees to develop and continuously improve the management system.
- A resistance to change owing to fears and perceptions about management systems, such as being bureaucratic and constraining. Again, this risk will be reduced through early communication about the strategy and management system, followed by training and development to understand the new processes and establish a new working culture.
- A lack of integration and coordination, that is, for example, the quality, health and safety, and environmental aspects are considered separately instead as a whole, or different work streams progress development work towards different expectations. This risk will be minimised through having a management system coordinator.
- A lack of experience and competence among the team, especially the management team and the management system coordinator. By ensuring the coordinator has the requisite skills, knowledge, experience and training, and that the management team has similar competence or receives appropriate training we can ensure that this risk is reduced.
- Burden of responsibility for the management system must be borne by the whole management team and not one single person, and that the management system coordinator receives the necessary support to support the implementation of the management system and its subsequent monitoring.

The risks associated with the success factors are:

Asset Integrity

There are two specific risks associated with the asset integrity success factor:

- We may not have the necessary competences or resources to maintain assets, or to manage contractors to undertake the work. This risk will be monitored through the asset integrity and resource planning processes (see “Asset Integrity” and “resource Management” sections), including the staff development process and performance indicators (see “Key Performance Indicators” section).
- The computerised maintenance management system (CMMS) may not suit the needs of our operation. This risk will be minimised by firstly, thoroughly understanding the operations and establishing basic processes before specifying and procuring a CMMS, and a key aspect of this will be to involve the technical support team from the beginning.

Resource Management

The main specific risk for resource management is that the range in the size and complexity of the projects undertaken and the resulting diversity of the operations may not be optimally supported by the management processes, e.g., they could be burdensome, time-consuming and bureaucratic for small projects. To minimise this risk, the intention is to understand the existing processes, establish working parties comprising representative team members to develop new processes and aim for a nimble, pragmatic approach.

Quality, Health, Safety and the Environment

The implementation of the integrated management system may prove too onerous, for example, with the available resources and competences, to implement within the desired timescale. Initially, a realistic timescale will be agreed with internal stakeholders and the necessary resources identified and secured. If the risk increases or progress falters and cannot be addressed through resources, the decision may be taken to focus on achieving certification against one standard, and then the others later.

Communication Plan

The strategy will be communicated internally to gain buy-in from internal stakeholders for the management system and ISO standards certification. Initially, the requirement for the strategy and the potential problems that it will help to prevent will be communicated to the whole academic, administration and professional and technical team of the centres.

Where necessary, individual work streams will be established to focus on specific areas of the strategy - and in particular, areas of the management system - to encourage participation in developing processes that will be effective.

Owing to the management system providing the vehicle for deploying much of the strategy, progress will be chiefly communicated through the interpretation of the key performance indicators (see “Key Performance Indicators” section) and the use of visual management techniques, such as infographics.

During the implementation phase of the management system, a monthly report to senior management will be prepared to inform them of progress, areas of concern and the next steps to be taken. An annual review and report will also be prepared for senior management (see “Review” section).

Staffing and Resource

The strategy will be developed and deployed by existing staff, including operations manager, technical team leader and quality, health, safety and environment coordinator. Other staff will be encouraged to be actively involved in its implementation and continued improvement.

Initially, other than standard office software, only a legal register will be used to ensure compliance and support the implementation of safety, health and environmental management systems.

As methods and discipline is established, software will likely be procured for asset and resource management.

Implementation Schedule

The implementation of the strategy will commence immediately through establishing some of the basic processes for planning, scheduling, operating and maintaining the facility.

Once the strategy is accepted by senior management, which is anticipated to be in Spring 2022, the implementation of more detailed aspects will commence and many of these will be partly driven by the implementation of the management systems for quality, health, safety and the environment, and a more detailed implementation plan will be prepared and executed.

The aim is to be ready for a Stage 1 assessment of the management system by the end of December 2022 and the Stage 2 audit by the end of March 2023.

Monitoring

The implementation of the strategy will be monitored through:

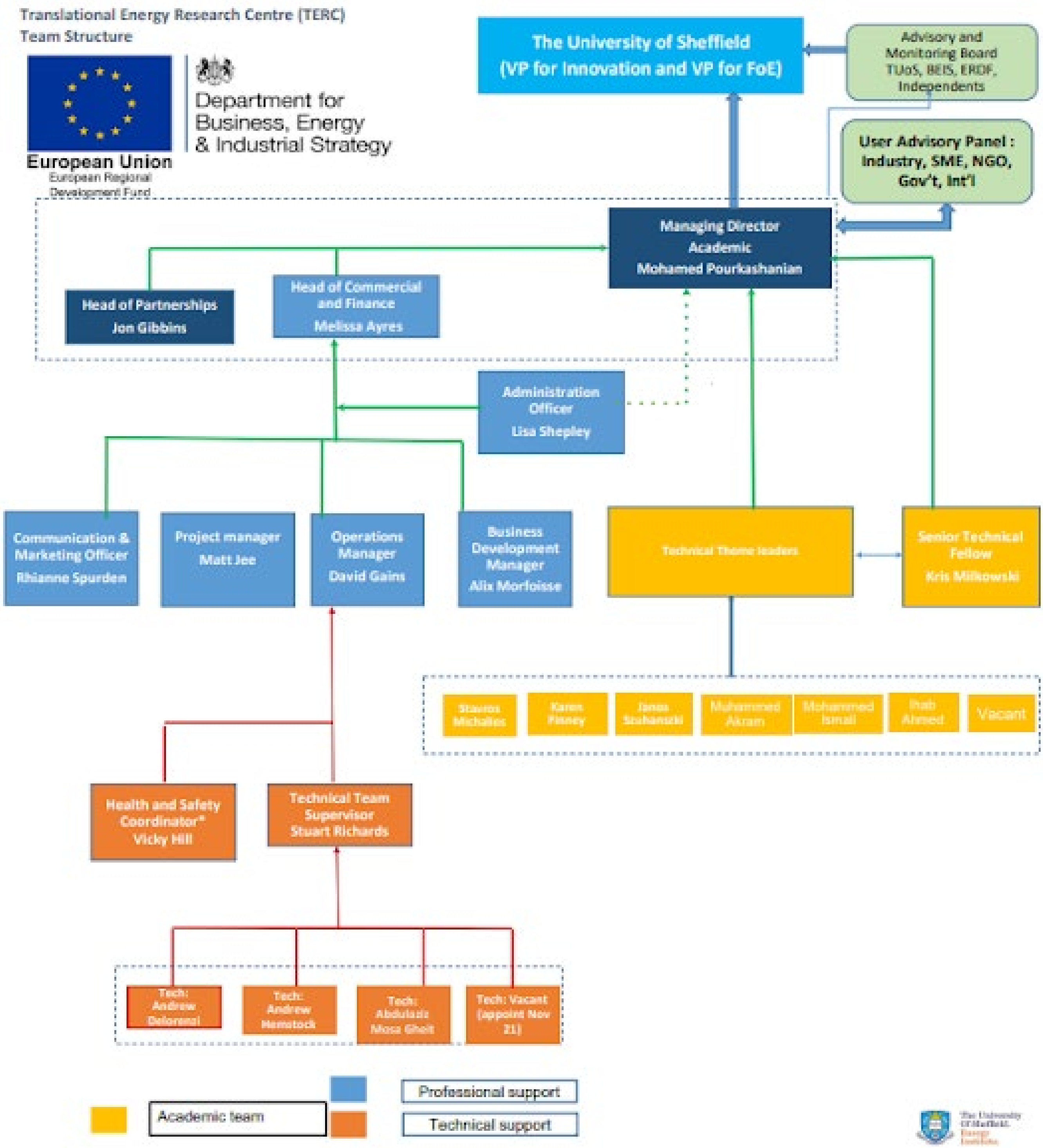
- Key performance indicators (see “Key Performance Indicators” section).
- Regular meetings, focussing on aspects of business activity, such as project technical meetings, health and safety meetings and the daily and weekly operations meetings (see “Resource Management” section).
- Implementation progress meetings to review progress of the implementation of the management system (and strategy) against plan.
- Health, safety and environmental inspections and safety tours of the workplace.
- Internal audits of project work as well as administration, technical and operations activities (see “Quality, Health, Safety and the Environment” section).

Review

There will be an annual review by the senior management team of the strategy and the performance of the management system to reaffirm or otherwise the suitability and impact of the strategy and the effectiveness of the management system.

Appendix 1

The following is the organisation chart for the Translational Energy Research Centre.



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