

Strategic Procurement Strategy

Earthworks Category Executive Update

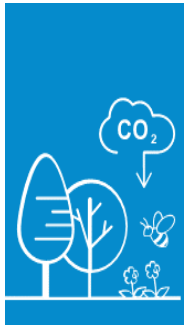
Executive Summary



Current Status: Earthworks construction is dynamic with many different activities all happening simultaneously. It is a competitive industry with high plant cost, high risk involvement and tight margins.



Challenges



- **Innovation:** Cost of investment in new technology, alternate environmental sustainable options and fleet management requirements.
- **Consolidation:** Multiple plant and equipment innovation projects. Dispersed investment and duplication of effort.
- **Operator Skills:** Ageing workforce, skills development and retention. Lack of plant and digital operators.
- **Capacity:** Increase in UK construction projects. Forecast capacity constraints within processing and disposal.
Both processing and disposal have a lower level of capacity than excavation, with disposal having the lowest of all, hence a potential market constraint.
- **Timeframes:** Ability of the market to respond to demand for new technology and alignment with OEMs.
- **Missed Benefit:** Unrealised opportunities through lack of co-ordinated supplier management across delivery schemes.

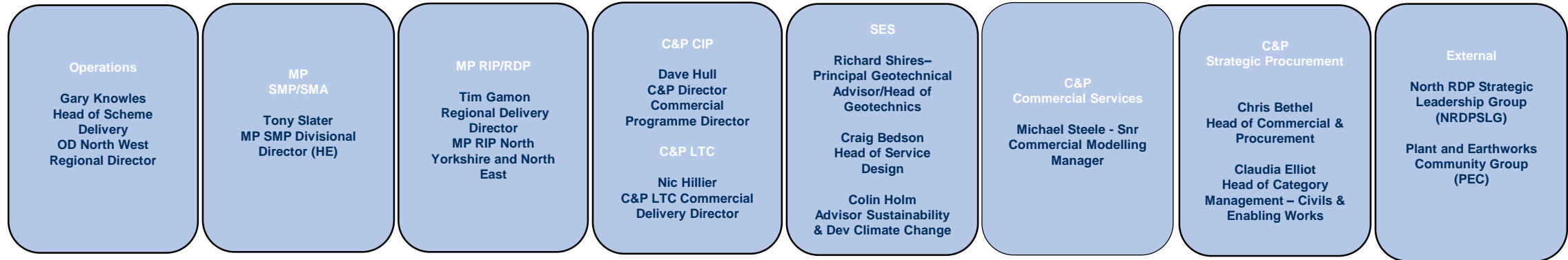


To fully address the challenges and to align with our imperatives, the strategy recommendations are as follows:



- **Carbon:** Develop a supply chain commitment roadmap aligned to the carbon reduction targets allowing the supply chain to plan ahead and invest.
- **Innovation:** Establish a capability, legislative requirements and implementation commitment plan for new technology and innovative solutions (specific to earthworks heavy equipment).
- **Planning and Design:** Early engagement of the supply chain in design for machines (planning, design value chain mapping, lean productivity solutions and behavioural).
- **Enterprise Agreement:** Supply chain enterprise alignment agreement to maximise capacity, productivity and efficiency opportunities.
- **Materials Management:** Environmental sustainability through reuse, repurpose and redeployment of materials, resources and waste to support carbon reduction.
- **Training and Development:** Support and develop social value through training, skills development and retention.

Engagement Matrix for Strategy & Approach



Business Area/Investment Programme:	Individual & Role:	Comment if required:	Review:	Date:
Executive Team – Panel Chair	Malcolm Dare - Executive Director C&P		Approval Meeting	21/7/2021
Executive Team	Duncan Smith – Interim Exec Director Operations		Exec Review	21/7/2021
Executive Team	Peter Mumford - Exec Director Major Projects		Exec Review	21/7/2021
Executive Team	Mike Wilson – Exec Director SES		Exec Review	21/7/2021
MP – RDP Leadership Leadership Team	Tim Gamon - Regional Delivery Director MP RIP North Yorkshire and North East (SRO)		Approval Meeting	16/7/2021
MP – RDP Leadership Team	MP - RDP Senior Leadership (NRDPSL)		Provided for Review	28/6/2021
C&P Leadership Team	Sanyalax Kelly - Strategic Procurement Director		Approval Meeting	22/7/2021
C&P Leadership Team	Andrew Stephenson - Procurement Director		Provided for Review	13/7/2021
C&P Leadership Team	Martyn Gannicott – Commercial Services Director		Provided for Review	13/7/2021
C&P Leadership Team	David O'Neil – Supply Chain Director		Provided for Review	13/7/2021
C&P Leadership Team	Mark Ollerton – MP Commercial Director		Provided for Review	13/7/2021
C&P Leadership Team	Richard Cerruti – Operations Commercial Director		Provided for Review	13/7/2021

Key Aims of Our Strategy



Carbon Net Zero:

Roadmap of carbon targets aligned to strategy implementation and supplier targets
Apply total cost of ownership methodology to all investment decisions (supply chain products and services) aligned to long term carbon reduction targets.



Planning and Design:

Specification and process for design for machines (not engineers). Planning for technology implementation and productivity.
Supply chain (Tier 2) early engagement in planning and design to maximise knowledge and skills and deliver value.



Material Management and Carbon Targets:

Value realised through category synergy development and alignment (site preparation, logistics etc).
Management of on-site material and resource (reduce, reuse, recycle). Circular economy and sustainability project. Mitigate disposal market constraints



Innovation and Carbon Targets:

Implementation of innovative solutions, alternate fuel (heavy equipment) to deliver productivity, efficiency gains and carbon targets.
Ensure alignment of multi project and programme innovation development and implementation plans (plant and equipment communities) to ensure a consistent approach and deliver value.



Project Alignment (Enterprise Agreement):

Supply chain enterprise agreement across schemes to maximise productivity, efficiency and increase speed of delivery.
Project alignment through redeployment of supply chain resources.



Training and Development:

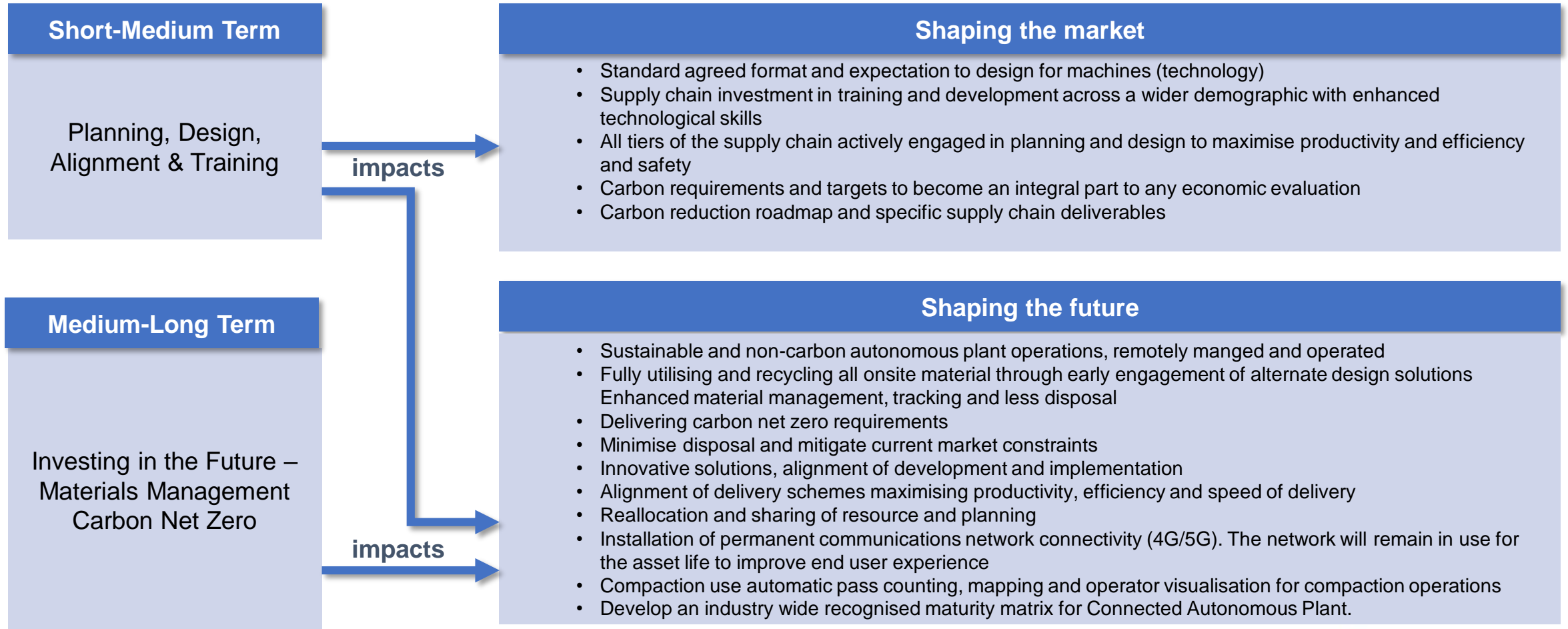
Support the development training opportunities in line with advancement in technology.
Technology opens industry participation to new and diverse demographic.

How will this deliver to the Business Objectives

Problem Statement/Challenges: Innovation, realised opportunities, consolidation, capacity and security of supply
 The problem statements/challenges that are addressed within the Earthworks Strategy can be summarised into the following key themes;
Planning and Design: designing for technology and machines, Innovation: delivering carbon targets, safety and productivity, Project Alignment: security of supply, Training and Development: delivering on social value and mitigating labour constraints and Materials Management: reduce, recycle and reuse.

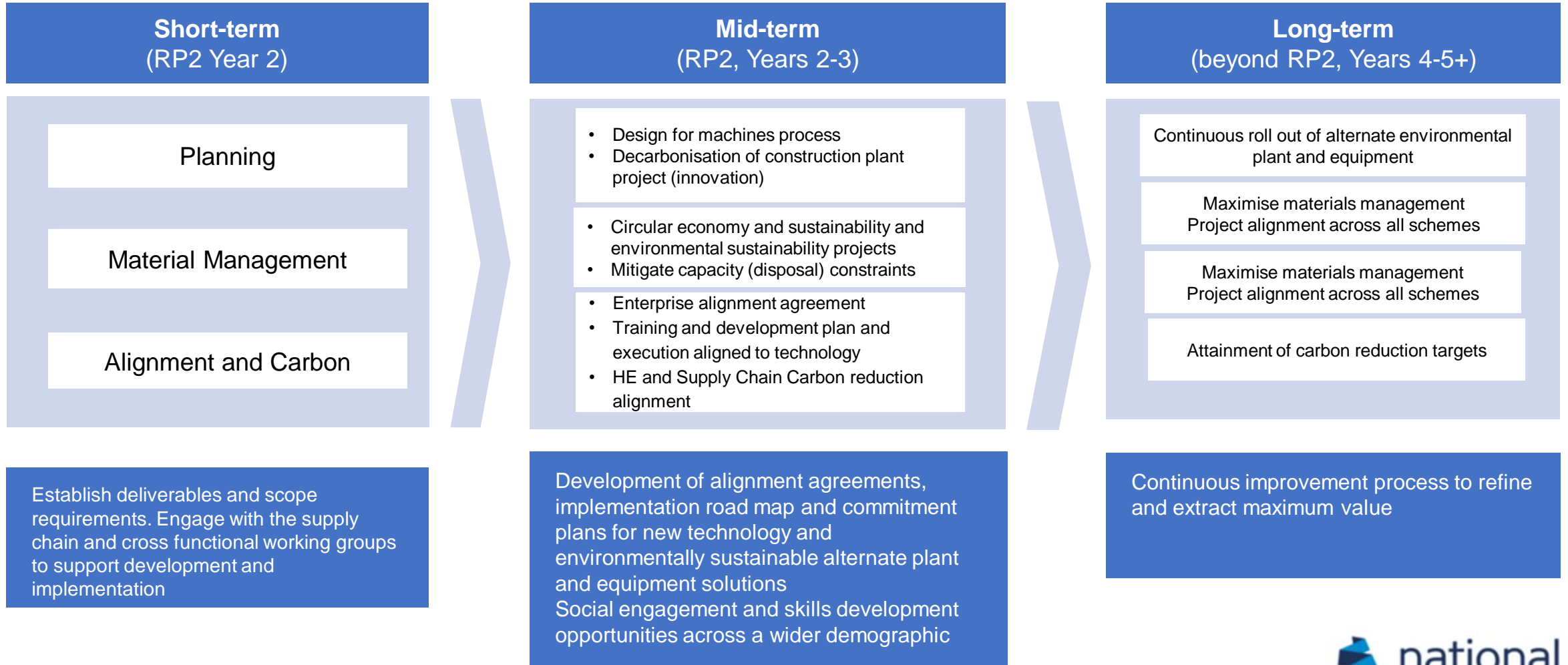
Directorate	Benefit/Objectives	Short	Medium	Long term
Operations	SDF in place (GENERAL CIVILS) Continue to update on developments	<ul style="list-style-type: none"> Engagement/Cross Category Collaboration 	Engagement/Cross Category Collaboration	Engagement/Cross Category Collaboration
Major Projects	<p>Planning and Design: Objective: Early engagement in the planning process and alternate design for machines. Benefit: Increased productivity / improved speed of delivery / carbon reduction.</p> <p>Innovation and Carbon Targets: Objective: Alternate fuel (heavy equipment) and innovative plant and equipment solutions Benefit: Influence supply chain investment / align with carbon net zero targets / remove man to machine interfaces / improve safety/reduced environmental impact / carbon reduction via data driven behaviour</p> <p>Project Alignment (Enterprise Agreement): Objective: Multiple scheme agreements, project alignment, redeployment of supply chain resources Benefit: Maximise productivity / efficient use of supply chain /mitigate cost increases / accelerate scheme delivery.</p> <p>Training and Development: Objective: Support the development training opportunities in line with advancement in technology. Benefit: New and diverse demographic / delivering on social value / operator capability / mitigate potential capacity constraints.</p>	<ul style="list-style-type: none"> Benchmark alternate design solutions against Scheme A1 Morpeth to Ellingham Benchmark alternate solutions against Scheme A1 Morpeth to Ellingham Plant innovation day 12/10/21 CAT Command demo 1/11/21 Benchmark alternate agreement solutions A1 Morpeth to Ellingham (B10) Alignment with labour strategy and on / off site training opportunities 	<ul style="list-style-type: none"> Replicate areas of best practice across SMA/CIP & LTC Supply Chain roadmap and commitment plan Influence original equipment manufacturers (Hydrogen) Leverage supply chain expertise to develop productivity and efficiency opportunities New technology/ training to support a diverse demographic and delivering on social value 	<ul style="list-style-type: none"> Continuous improvements to support RP2/RP3 Supply Chain Fleet upgrade Deliver zero fossil fuel on all heavy machinery Continuous security of supply forward planning and delivery Continuous training development process aligned with industry and technology changes
SES	<p>Material Management and Carbon Targets: Objective: Management of on-site material and resource (reduce, reuse, recycle). Benefit: Efficiency through material management, reduced cost, carbon reduction mitigate disposal capacity constraints reputation.</p>	<ul style="list-style-type: none"> Participate within the Major Infrastructure – Resources Optimisation Group (MI-ROG) Environmental Materials Management Project (waste, recycle and standards) initial feasibility 	<ul style="list-style-type: none"> Implementation, structure and benefit analysis realised for further roll out across schemes 	<ul style="list-style-type: none"> Establish a national collaboration agreement

Snapshot on Our Future Vision



This is a high level picture. We will develop different aspects further with stakeholders across all solutions as our implementation plan progresses

Phased High-Level Implementation Plan to Deliver Our Key Aims



Rollout of Short-Medium Term Solutions



Rollout of Medium-Long Term Solutions



Acronym

CAP: Connected and Autonomous Plant

PEC: Plant and Earthworks Community

SCS: Supply Chain School

Recommendation Summary

Earthworks Strategy	Requirement	Benefit	Imperatives
Carbon Net Zero	<ul style="list-style-type: none"> Targets and implementation roadmap 	<ul style="list-style-type: none"> Define HE requirements and expectations Establish alternate sources of supply Incentivise the supply chain to be proactive (TCO) Clear guidance and expectations of delivery Supply chain time to plan and invest. 	<ul style="list-style-type: none"> Delivery Customer
Planning and Design	<ul style="list-style-type: none"> Design for machines process and implementation 	<ul style="list-style-type: none"> Utilisation and cost control of machinery aligned to scope of work Maximise the planning, productivity and efficiency gains and support operations on site machine interfaces Currently no specification for design to machines. The design community and the Plant and Earthworks Community to solve this together (buy in from Trimble/Leica/ Topcon) 	<ul style="list-style-type: none"> Delivery Customer Safety
Material Management	<ul style="list-style-type: none"> Circular economy and sustainability and environmental sustainability project Utilising the carbon tool 	<ul style="list-style-type: none"> Reduction in waste materials, transportation and landfill and reduction in carbon (reduce, reuse, recycle) Tracking waste Utilising HE carbon tool to define resource efficiency Internal and external excavated materials, including soil Aggregates – mapping from quarry to end of life Consider carbon in economic appraisals Utilise HE Carbon calculation tool to enhance decision making Mitigate capacity constraints within the disposal sector 	<ul style="list-style-type: none"> Delivery Customer
Innovation	<ul style="list-style-type: none"> Decarbonisation of construction plant project (innovation) Alignment on CAP (connected and autonomous plant), PEC (plant and earthworks community) and SCS (supply chain school) innovation and technology developments 	<ul style="list-style-type: none"> Remove man/machine interfaces and improve safety Optimise plant movements and improve cycle times Contribute towards our carbon net zero target Reduced environmental impact Reduce waste (time, money and effort) Increase speed of implementation 3D Machine control productivity gains <i>(Alignment with general plant and equipment strategic procurement strategy for environmental sustainable equipment solutions)</i> 	<ul style="list-style-type: none"> Delivery Customer Safety
Project Alignment	<ul style="list-style-type: none"> Enterprise alignment agreement Potential to utilise on the A66 	<ul style="list-style-type: none"> Maximise productivity and efficiency (supply chain) 	<ul style="list-style-type: none"> Delivery Customer
Training and Development	<ul style="list-style-type: none"> Support the development of training facilities Encourage social value 	<ul style="list-style-type: none"> Support technology developments and implementation Mitigate future skills and capability requirements Deliver on social value (open to a wider demographic) 	<ul style="list-style-type: none"> Delivery Customer Safety

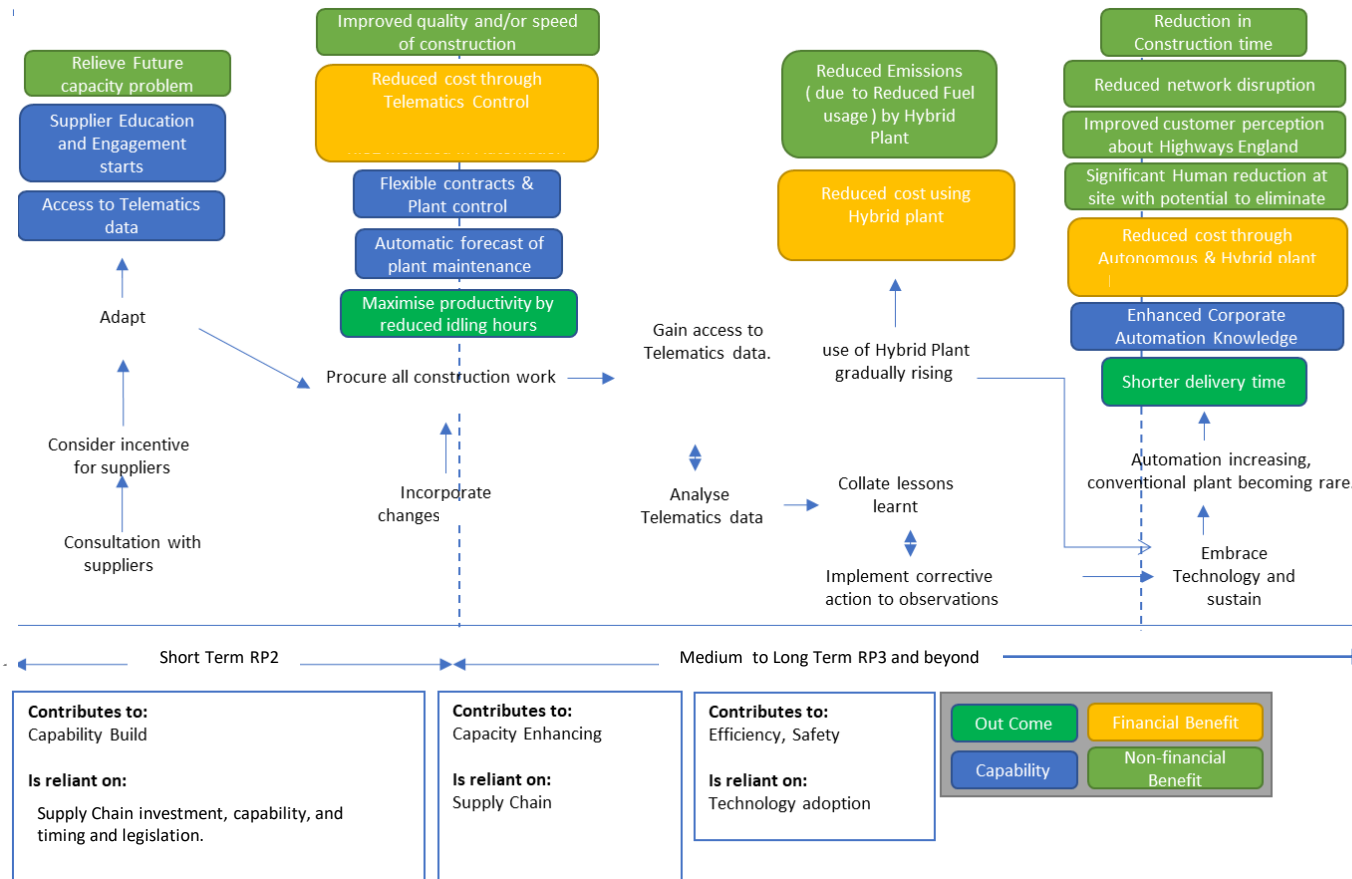
For further detail refer to *Strategy - Short to Medium to Long Term* slide

Opportunity Analysis: High-Level Implementation Plan

Opportunities	Activities	2021	2022	2023	2024	2025
Carbon	Implementation Plan and Targets	█	█			
Planning and Design	Design for Machines	█	█			
Material Management	Circular economy and sustainability project	█	█	█		
Innovation	Decarbonisation of construction plant project (innovation)	█	█	█	█	█
Project Alignment	Enterprise alignment agreement across all of MP (Opportunity to initially develop on the A66)	█	█			
Training and Development	Support the development of training facilities	█	█			

Value Chain Analysis: Key Benefits & Transformation Map

The below flow diagram outlines indicative transformational opportunities, dependencies and benefits with the implementation of autonomous and hybrid plant, telemetric and data controls across RP2, RP3 and beyond



Value Chain Analysis: HVO Fuel Benefits

A recent study identified the benefits both in terms of cost, emission reduction and health and safety by using HVO as an alternative to fossil fuels.

Given the pending transition from red to white diesel in April 2022 with an forecast price increase in cost approx. £0.47 per litre this offers a cost effective, low emission and safe alternative.

What is HVO?

HVO is a crop waste fuel that can be used as alternative fuel to fossil fuels such as diesel.

- HVO is much cleaner than traditional fuels such as diesel, with obvious benefits to the environment. It can be utilised in any combustion engine, particularly to generate electricity in a temporary power generation application.
- HVO power solutions require no component change or modifications to the combustion engine. This means the operator can use HVO as an immediate replacement fuel in assets that are currently being run on diesel.

Emission Reduction

- 90+% reduction in net CO₂ – calculated and confirmed by the ISCC.
- > 15% reduction in NO_x emissions.
- > 40% reduction in particulate matter.
- Fuel consumption reductions of up to 10%.

Health and Safety

- Unlike red diesel HVO carries no carcinogen warning on the Safety Data Sheet making it less harmful to human health.
- Unlike red diesel HVO does not harm the environment water table and is biodegradable.
- Orders less than 1,000 litres 20-25% increase vs red diesel
- Orders from 1001 -10,000 litres 15-20% increase vs red diesel
- Orders from 10,001 - 36,000 litres 10-15% increase vs red diesel
- National delivery – up to 2.5million litres can be supplied per month on a two - three-day lead time, seven days per week, 365 days per year with emergency same day deliveries on request.

Value Chain Analysis: Circular Economy Thinking

Major Infrastructure–Resource Optimisation Group (MI-ROG)
Optimisation of circular economy thinking to manage material

ICR Themes	Circular economy thinking
<p>Build nothing Challenge the root cause of the need; explore alternative approaches to achieve desired outcome</p>	<p>Retain Maximise the use of existing assets to reduce the extent of new construction required Design for durability, longevity, and adaptability Apply procurement approaches that encourage service and performance</p>
<p>Build less Maximise the use of existing assets; optimise asset operation and management to reduce the extent of new construction required</p>	<p>Re-use, reclaim, re-cover Follow the hierarchy of re-use Condition-based maintenance Share materials information with other projects/industry sectors Data and the digitisation of infrastructure as an enabler of both low carbon outcomes and circular economy action plans</p>
<p>Build clever Design in the use of low-carbon materials; streamline delivery processes; minimise resource consumption</p>	<p>Re-think Use less material Extract maximum value from resources Select construction materials with low carbon intensities Select local materials, minimising material movements Use renewable energy for materials movement</p>
<p>Build efficiently Embrace new construction technologies; eliminate waste</p>	<p>Optimise Using new technologies, e.g. for: Material re-use Resource efficiency Flexibility and adaptability End of life (disassembly and re-use) Design to minimise waste, use greywater Design to enhance natural capital/carbon storage</p>

Carbon strategy

Key drivers of carbon emissions in category	Corporate emission	Maintenance & construction emission	Road user emission	Estimated Carbon emissions per year associated with key driver [tons of CO2]
1. Materials Management 2. Design and Planning 3. Decarbonisation of Construction Plant		x		*pending volume analysis and decarbonisation of plant roadmap project and CAP

Identified measures to address key drivers in category	Expected impact / CO2 reductions [tons of CO2]			Timescale	What is needed to implement measure (investment/support, etc)?
Materials Management Imported Soil (tonnes)	General soil/top soil	Carbon Factor 0.024	Factor Units: tCO ₂ e/t	2022- 2024	Management of on-site material and resource (reduce, reuse, recycle). Circular economy and sustainability project Planning and design
	Stabilised soil - Cement, Fly Ash or GGBS	Carbon Factor 0.058	Factor Units: tCO ₂ e/t	2022- 2024	
Mixed Construction Waste (tonnes)	Recycled	Carbon Factor 0.058	Factor Units: tCO ₂ e/t	2022 -2023	
	Landfill	Carbon Factor 0.458	Factor Units: tCO ₂ e/t	2022/2023	
Alternate Fuel Source	Electricity (kWh)	Carbon Factor 0.233 (CF 0.001)	Factor Units: kgCO ₂ e/kWh	2022-2025	
	Biodiesel (kg)	Carbon 0.540 (CF 0.001)	Factor Units: kgCO ₂ e/l	2022-2025	

Category Profile

Vision:

Sustainable and non-carbon autonomous plant operations, remotely managed and operated and fully utilising and recycling all onsite material through early engagement of alternate design solutions ensuring on-time delivery of customer, exceeding value deliverables, zero safety incidents and delivering carbon net zero requirements.

Goal:

Due to increased demand on the existing supply chain from other major programme projects outside of HE there is a requirement to ensure that HE have sustainable procurement, capacity coverage and continuity of capability and skills throughout the supply chain to both undertake all and accelerate HE requirements, deliver forecast savings, carbon targets, safety and delivery to the customer

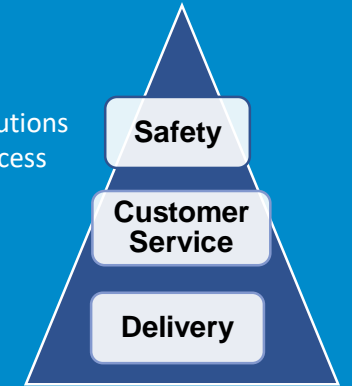
Scope:

Earthworks construction is dynamic with many different activities all happening simultaneously. It is a competitive industry with high plant cost, high risk involvement and tight margins.

Opportunities:

- Implementation of technology and innovative solutions
- Supply chain collaboration, planning and lean process
- Skills and capability development
- Material management
- Deliver:
 - Social value expansion
 - Environmental net zero carbon targets.
 - Productivity and efficiency gains

Business Need



Earthworks Strategy Summary

Landscape:

The landscape of suppliers within the earth moving community are composed of the following supply base:

- Specialist Earthwork Contractors
- General Civil Engineering Contractors
- Plant Hire Contractors and
- Manufacturers (Plant and Equipment)

Market Analysis:

The market is fragmented with a large number of Tier 1 and Tier 2 (who dominate the market) Tier 2 suppliers are mainly mid-sized companies that offer a variety of services and have local/regional presence.

Operating earthmoving equipment, requires technically skilled labour therefore the market can be negatively affected by resource capacity and capability pressures.

Strategic Approach

Opportunity Analysis: High-Level Implementation Plan			
Objectives	Year 1	Year 2-3	Year 4+
Carbon reduction gains	Define plan and targets	Align with market capability	Continuous reduction
Planning & Design	Productivity solutions & behaviour requirements	Implementation defined projects	Continuous enhancement of productivity
Innovation	Selected trials to define productivity gains and safety	Road map to Implementation	Continuous development
Material Management	Define options and implementation	Implement design and management process	Continuous reduction in disposal
Project Alignment	Define opportunities and process	Implement options (trial)	Extend across MP
Training and Development	Scale of requirement v capability	Expand on implementation plans	Revisit and revise

Statement of need



A Safer Network

- Accelerate the implementation of innovation.
- Remote operator adoption
- Performance management

The Requirements

Due to increased demand on the existing supply chain from other major programme projects outside of HE there is a requirement to ensure that HE have sustainable procurement, capacity coverage and continuity of capability and skills throughout the supply chain to both undertake all and accelerate HE requirements and delivery to the customer



Improving Customer Satisfaction

- Early contractor involvement in the early planning and design stages
- Specific productivity, environmental / carbon and social value targets.

The Objectives

- We want to access the capability and expertise of our specialist Tier 2 suppliers
- We believe that better planning and design of earthworks has the potential to improve productivity
- We want to encourage the use of new plant, such as remotely managed and operated autonomous fully electric plant



Delivering the RIS

- Demand planning.
- Supplier capability and skills retention
- Supply chain ownership
- Influence the market

The Challenges

- Develop capacity and skills of plant operators, digital plant people. remote operator adoption
- Scale of capex required to keep pace with rate of change in digital and renewable areas and fleet management
- Further develop the plant and earthworks community o drive further collaboration utilising industry expertise across OEMs and supply chain influencing the market

The Outcomes

- Greater re-use of material on-site and less off-site disposal
- Better match of plant to the nature and scale of the work
- Reduce the number of people involved in the operation and remove man/machine interfaces and improve safety
- Optimise plant movements and improve cycle times
- Contribute towards our carbon net zero target

Conclusion:
Increase in UK construction projects will put constraints on the supply of plant and resources. New technology will create efficiencies and improved safety however the cost of investment in innovation is seen as prohibitive which also leads to the challenge of retaining an ageing workforce and attracting new skills and capabilities inline with technological advances.



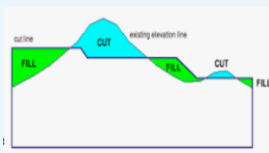


Business requirements and objectives

Requirement	Low Importance	1	2	3	4	5	High Importance
Assurance of supply	Disruption to supply has a minor impact on operations and / or brand perception					X	Security of supply is critical, disruption will affect safety and damage reputation
Quality	Quality issues have minimal impact on operations and/or					X	Quality performance has a major impact on our operations and/or brand
Regulatory, Ethical, Environmental	Compliance to ethical, environmental or regulations have a minimal impact on our operations or our brand					X	Compliance to regulatory, ethical and environmental issues has high impact on our operations and/or our brand
Service	Flexibility in delivery dates and service levels can be accommodated with minimal impact.					X	Late deliveries / poor service has a major impact on operations / brand
Cost	Cost competitiveness is not a major requirements.				X		Cost competitiveness is highly important for the business as is the ability to understand costs drivers of product / service
Innovation	R&D capability or investments in innovation has minimal impact on operations and/ or brands.					X	Excellent R&D / product engineers and investments to innovate are critical to our operations and/or brand





HE Directorate	Specific Objectives
CIP	<ul style="list-style-type: none"> Over reliance on frameworks Enterprise based procurement Influence the supply chain how do we influence and get value back Influence Tier 1
RIP	<ul style="list-style-type: none"> Shifting design to deliver outcome Understand sub tier supply chain Enterprise agreements
Operations (Asset Delivery)	<ul style="list-style-type: none"> Professionalise Tier 2 contractors and the way Tier 1 deal with Tier 2 opportunity Minimal opportunity for this category
SMA	<ul style="list-style-type: none"> Embedded as part of the wider Alliance enterprise Early involvement in projects and engagement in collaborative planning.
LTC	<ul style="list-style-type: none"> Advised to early in the process to consider earthworks Supportive but plan to revisit at the appropriate time

Conclusion: The Earthmoving sector is a highly complex and fragmented in terms of resources i.e. manpower and plant required to carry out works. The supply chain is paramount to the success of earthworks projects as any delays or disruptions will have a knock on affect to the success of the project.




Product description

Name	Description	
Earthworks 		<p>Earthworks, in its simplest form, involves processes such as excavating, hauling, dumping, crushing and compacting. Earthmoving operation consists of the preparation of material, the loader/truck loading cycle, haulage of trucks to the disposal place, the depositing of the material and the trucks return trip to the loading station to start another load-and-haul cycle. Soils are heavy and roads are long, roadway design not only needs to balance cut and fill but also try to minimise the haulage distance</p>
Specialist Earthworks Services 		<p>Bulk excavation Cut and fill. Reduction of level dig operations Basement excavations Removal of stock piled soils Bulk soil disposal and haulage of inert, hazardous and non hazardous waste Remediation and ground improvements Soils treatment & remediation Soil stabilisation Treatment strategies for contaminated sites Typography of the existing land. Curved Box jacked excavation</p>
Cut and Fill 		<p>Geotechnics is an engineering discipline that deals with soil and rock behaviour. It also involves slope stability, risk of landslides and rock fall. Cut and fill are the most fundamental concepts in any earthwork projects and keeping the fill and cut in balance with one another is a critical part of the road engineering. If there is a need to fill in areas rather than import it from somewhere it is more efficient to take it from an area that already needs it to be removed.</p>
Soils (Geology) 		<p>Soil is not strong (especially when its loose) therefore needs compacting . Testing soils is the most common activity. Soil is an important material to construction. We need to make sure the roads we build have strong foundations, which means proper compaction. Soils settle and compress over time however it is better it is compact in construction rather than after as it will deteriorate the road. Operations are often impacted by geographical areas uncertainties in the ground conditions making difficult to forecast and plan operations accurately</p>
Fleet (Plant) 		<p>In modern construction is completely mechanised and is performed by highly efficient machinery also known as plant. Operations require specially designed heavy equipment with significant purchasing/leasing price, as well as high operating and maintenance costs The typical types of plant used in earthworks are of varying design and load capacity depending complexity and size of the projects. Typical plant used include excavators, articulated dumpers, loading shovels, rollers, tractors, dozers</p>









Product Description

Name	Description	
Environmental		<p>There is the need to reduce fuel consumption for articulated haulers which are the most fuel consuming machines in earthmoving. Fuel consumption has become one of the main focuses for plant manufacturers. Reducing carbon footprint, minimising air pollution, use of cleaner, quieter electrified machinery gains would be achieved productivity by extending the working hours and better for the environment</p>
Resource		<p>Skilled operatives are crucial in earthwork operations and are very much at the front end of projects. The cost of manpower is considerable due to reasons like rough working conditions and the training process of the equipment operators. Construction operations are complex systems where many resources (equipment and manpower) requires collaboration to perform tasks. Lack of skilled resource or plant will delay and impact on the sequence operations significantly</p>
Digitalisation (Technology)		<p>Earthworks is going through a digital revolution, where technology is supporting decision making and offering significant productivity improvements. Data can be collected from connection to earthmoving machines, devices and drones saves and shares from the cloud, construction managers on earthworks projects will have a much greater understanding of what work has been done and whether they are on track to the next phase or work</p>
Autonomous Vehicles		<p>Smart systems include digitalisation solutions where machines can talk to each other to increase the productivity and quality of earthmoving and making the work safer and more sustainable. Taking away the hard dirty work of earthmoving projects bringing the idea of digitalised robots and innovation in technology. HE is automating earthworks activities by using semi-autonomous machine control excavation via (Komatsu, BOMAG and Volvo) on the A19 Testos roundabout. All i3P clients will reference where appropriate the i3P CAP statements in their business process and procurement to accelerate and transform industry adoption of connected and autonomous plant</p>







Product Description

Name	Description	
<p>A connected site</p>		<p>The future of a connected site is a system of technology and processes which bring together a data rich safe and productive work site. Meaning materials can be tracked on, autonomous machined are programmed with digging data. People are kept at a safe distance from working plants and people working on site have detailed understanding of what is happening where everything is including buried utility assets. Aerial monitoring of the sites which is tracking progress through satellites and drones there is good communications facility which can beam data, real time data back to the control rooms</p>
<p>i3P</p>		<p>The connected and autonomous road map was launched in June 2020 in partnership with a organisation called i3P. i3P unite a whole host of infrastructure clients such as HE, HS2, TRL, energy companies with our wide range of supply chain of industry experts manufactures, subcontractors. The road map runs from 2020 to 2035 and looks at the current state, people and society, technology and hardware, data and digital techniques which leads to the future vision Road Map Link</p>
<p>CAP Statement</p>		<p>The CAP community have issued CAP Community commitment statement to lead and accelerate the roadmap to a connected arena. Some example of areas the CAP community is asking the clients to reference i3P CAP statements within their business processes. Other examples to really drive the change include review the possibility for early installation on connectivity installation (4G/5G) at their locations. For example in Designs the community request designs for machines in a digital format which will allow automated design from drawings to machine. In procurement –encourage the adoption of CAP technology where there is a clear whole life business case to be produced. And machine manufactures to comply with Part 4 ISO 151143 to allow data exchange between different types of equipment and acceptance from design. Link</p>









Innovation in the Category

Innovation Theme	Description	Key Innovators	Exemplary Products
Rapid digital adoption	<p>Smart systems include digitalisation solutions where machines can talk to each other to increase the productivity and quality of earthmoving and making the work safer and more sustainable. Taking away the hard dirty work of earthmoving projects bringing the idea of digitalised robots and innovation in technology. Volvo Construction Equipment (Volvo CE) has announced that its three-year collaboration with Trimble Inc. has resulted in the development of an integrated Trimble® Earthworks Grade Control Platform for Volvo Dig Assist 2D machine control system. Designed for use with Volvo CE's wheeled and crawler excavators</p>		
"DIGGER"	<p>The process starts with the creation of a digital 3D model, using Trimble Business software, supported by the Trimble Tilos project planning software to measure material excavated, which is then tagged using in-cab controls. The aim is to optimise performance of the load and haul fleet and the progress of grading and compaction operations https://www.competefor.com/ekfb/ Case Example: DIGGER has been developed by Eiffage Kier and Caterpillar dealer Finning to deliver a section of HS2 project with earthworks volume of up to 32million Cu m of cut and fill for its 80km section.</p>		
Self Driving Dumper Trucks	<p>The truck is programmed remotely to follow a pre-determined route and has the capability to detect and avoid obstacles and vehicles along the route it drives. Leading works to carried out around the clock and reduction of risk of road workers being involved in incidents on site, It is predicted it will take another 2 or 3 years before autonomous dump trucks are in full operation Case Example: HE have trialled self driving dump trucks costing £150K on A14 in partnership with CA Blackwell</p>		
Digital twins on earthworks projects	<p>A 'connected site' concept by Leica showcased in America could be the new model for infrastructure schemes. Digital twins on site, including tablets used by construction managers and machine control technology connect with 3D models. The data capture creates a digital twin of large infrastructure project from planning stage through to earthworks construction phases. The adoption is accelerating since HE recently mandated the use of 3D machine control on its projects and HS2 is now looking at the connected model</p>		

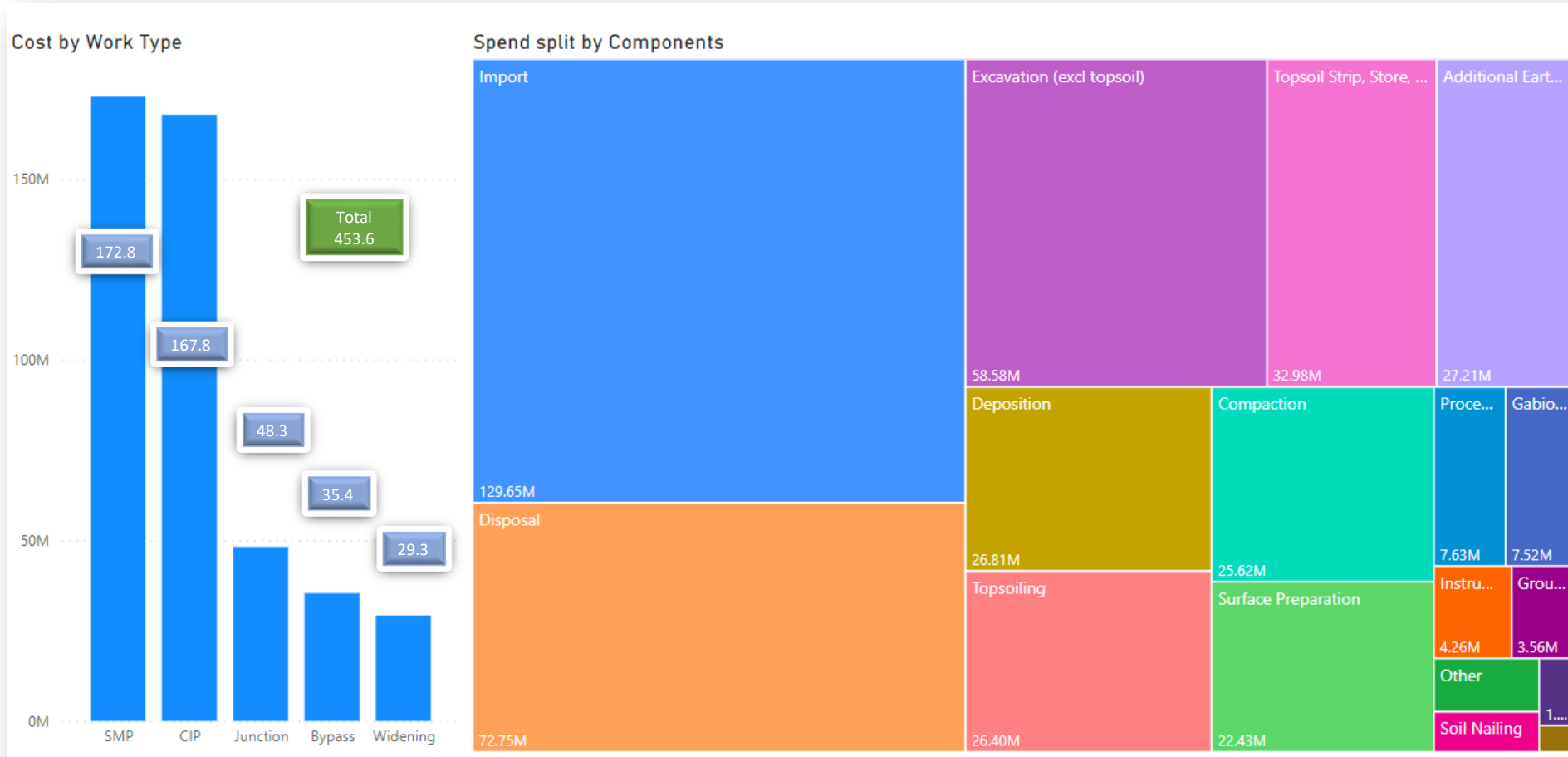
Innovation in the category

Innovation Theme	Description	Key Innovators	Exemplary Products
<p>Digital Technology 3D & GPS</p>	<p>Recent advances in digital technology used with construction machinery are offering significant productivity improvements. Equipment manufacturers such as Komatsu and Caterpillar are leading the way in machine control technology – where 3D terrain models and global positioning system (GPS) tracking are used to position and guide earthmoving equipment – and say that at least a 30% increase in productivity is achievable; opening up potential productivity improvements in the earthworks sector Case Example: Collins Earthworks were the first with Trimbles 3D dozer control and have a full suite of Trimble equipment and software supported onsite and remotely by SiteTech</p>		
<p>Drones Technology</p>	<p>Drones are used to for site surveys and check the earthworks progress. Utilising an adapted 4x4 with sophisticated drone equipment such as a Trimble GPS receiver on the roof and Trimble siteworks tablet in the passenger seat . With this technology it is possible to view live earthworks model from any location on the site, using a colour touchscreen display to change perspectives. After a survey flight is complete the drone data is uploaded into the Timble Stratus Drone platform which helps surveyors and project managers visualise the project on a week-by-week basis Case Example: Utilisation on the HS2 near Southam to execute mass muck shift https://www.youtube.com/watch?v=pRk4QxR3xIU</p>		
<p>Dual View DV 60</p>	<p>This concept by Wacker Neuson allows the operator to turn the seat and console 180 degrees to determine the viewing and driving direction. The operator always has full visibility ahead when unloading, meaning more visibility means more safety. The rotation can be easily performed from the driver's seat by simply unlocking the seat console and then turning it around. The kit includes heating and air con- therefore the welfare of the operator is dramatically improved https://www.wackerneuson.co.uk/en/products/dumpers/dual-view-trucks/model/dv60/</p>		

Innovation in the Category

Innovation Theme	Description	Key Innovators	Exemplary Products
Zero Carbon hydrogen – powered excavator JCB 22t 220X machine	<p>JCB makes history with the world's first hydrogen powered excavator in July 2020. The 20-tonne 220X excavator was in development for 12 months and underwent rigorous testing at JCB's quarry grounds for a further year. The excavator is generated by reacting hydrogen with oxygen in a fuel cell to create the energy needed to run electric motors, the only emission from the exhaust is water. JCB continue leading the sector on zero and low carbon technologies</p> <p>https://www.jcb.com/en-gb/news/2020/07/jcb-leads-the-way-with-first-hydrogen-fuelled-excavator</p>		
JCB Electric mini digger JCB E-Tech	<p>The industry's first electric mini excavator with zero emissions at point of use. JCB state it can work a full days shift on a single charge and offers the same performance as a conventional 1.9t mini excavator. The machine is five times quieter than its diesel counterpart and can be fully charged in under two hours. JCB state the charging cost will be 50% cheaper than running an equivalent machine on red diesel and servicing costs are expected to be 70% lower than diesel machines</p> <p>https://www.jcb.com/en-gb/products/mini-excavators/19c-1e</p>		
Road to cleaner plant	<p>Skanska and Volvo tired out the world's first emission free quarry in Sweden, where every stage of the process has been electrified. Tests shown a 98% reduction in carbon emissions, 7% reduction in energy cost and 40% reduction in operator costs. The equipment included trialled battery electric load carriers, 70 tonne dual powered cable connected excavator and electric hybrid wheel loader. The machines are currently prototypes and not commercially available yet</p> <p>https://group.skanska.com/media/articles/creating-the-world-s-first-emission-free-quarry/</p>		
Hyundai Hydrogen-Powered diggers	<p>Korean manufacture's Hyundai Construction Equipment have set a target to start mass distribution of medium/large capacity hydrogen fuel excavators in 2023. They are working in conjunction is Hyundai Motor Group and Mobis and are also looking to develop hydrogen powered forklifts. Hydrogen based electric construction equipment uses electricity produced through chemical reactions between hydrogen and oxygen as the power source, therefore no emissions of toxic gases in the air</p> <p>https://www.hyundai-ce.eu/en/news/2020-03-pr-hyundai-hydrogen-fuel-excavators</p>		

Historical Spend RP1 (based on target prices with inflation adjustment)



Conclusion:

- Spend data based on HE payment directly to earthworks suppliers
- Import and disposal accounts for approx. 44% of total spend and a potential efficiency improvements with improved design and reusable materials

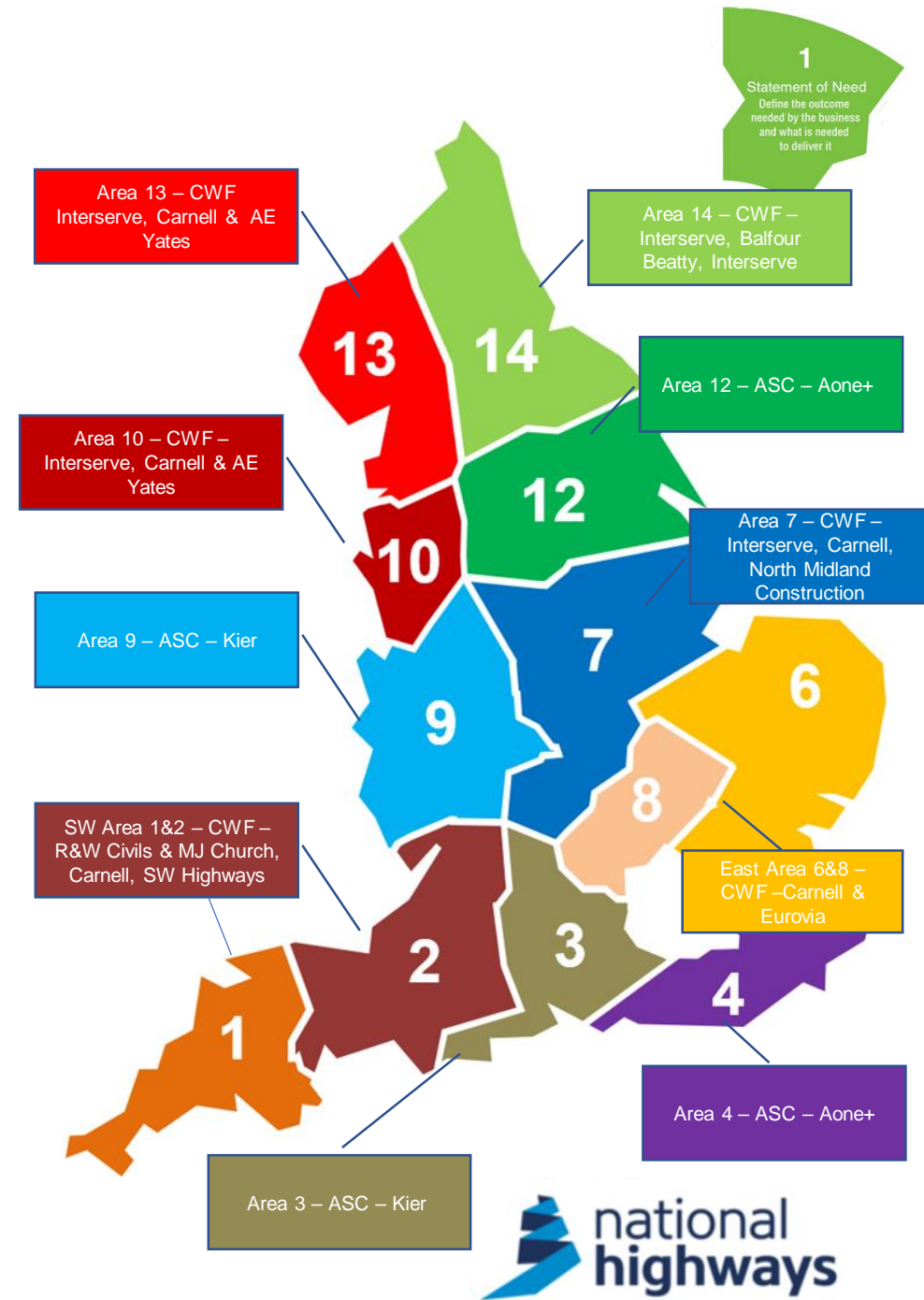
Current Sourcing & Contract Options

Delivery Model	Procurement Method	Advantages	Disadvantages
Asset Delivery – CWF transitioning to SDF	SDF contracts will succeed CWF which lapse by area, many between 2021 & 2023	Allocation allows share to be managed between regional competitors with regard to performance and capacity	Competitive leverage will reduce following the appointment of SDF suppliers.
Asset Delivery	Tier 1 Contractor appoints Tier 2 sub-contractor.	Potentially introduces some SME's and non CWF / SDF suppliers, reducing barriers to entry and developing capability	Tier 1 may procure on a least cost basis HE no influence on Tier2 selection
Major Projects SMP	Direct contract with principal contractor on a scheme-by-scheme basis	SMP Alliance able to leverage existing relationships for deliver, efficiency and safety	Uncertainty in regard to alliance operating model managing supplier performance and innovation
Major Projects RIP	Direct contract with RDP on a scheme-by-scheme basis	Mechanism exists to co-ordinate with DIPs through Sustainable Supply Chain Group.	HE unable to drive standards and delivery performance improvements Risk to cost over value in supplier selection
Complex Infrastructure Projects	Direct contract with principal contractor on a scheme-by-scheme basis	Principle contractor to contract on a project-by-project basis	Delivery dependent upon principal contractor. Risk to cost over value in supplier selection

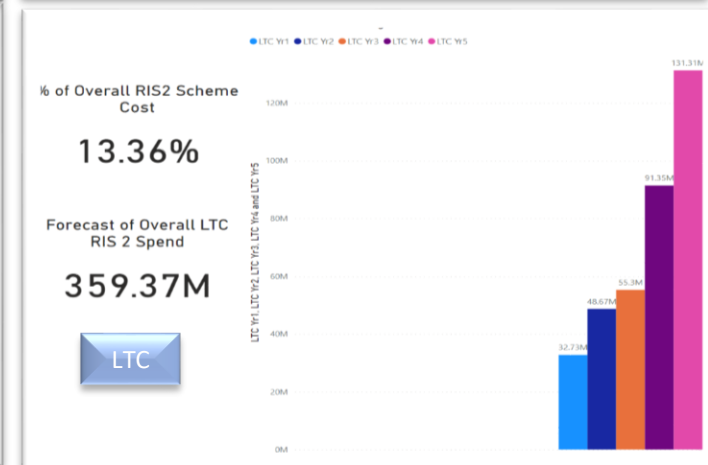
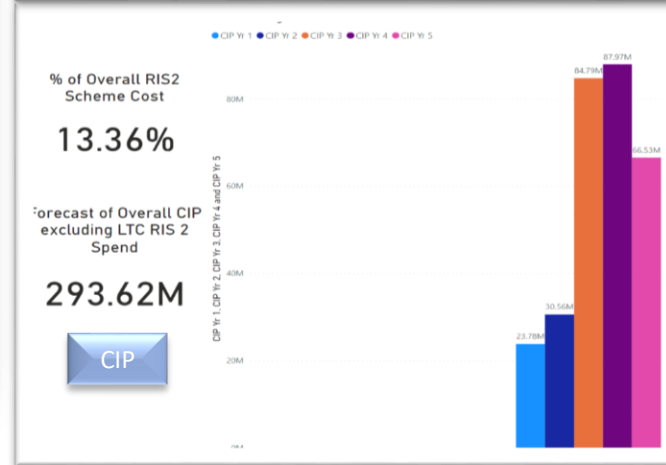
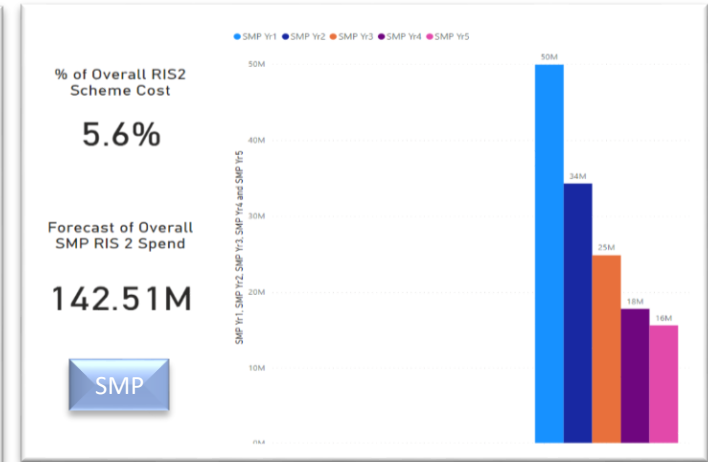
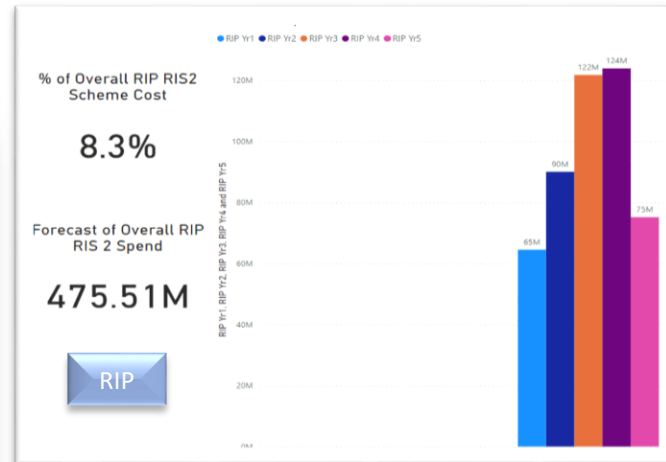
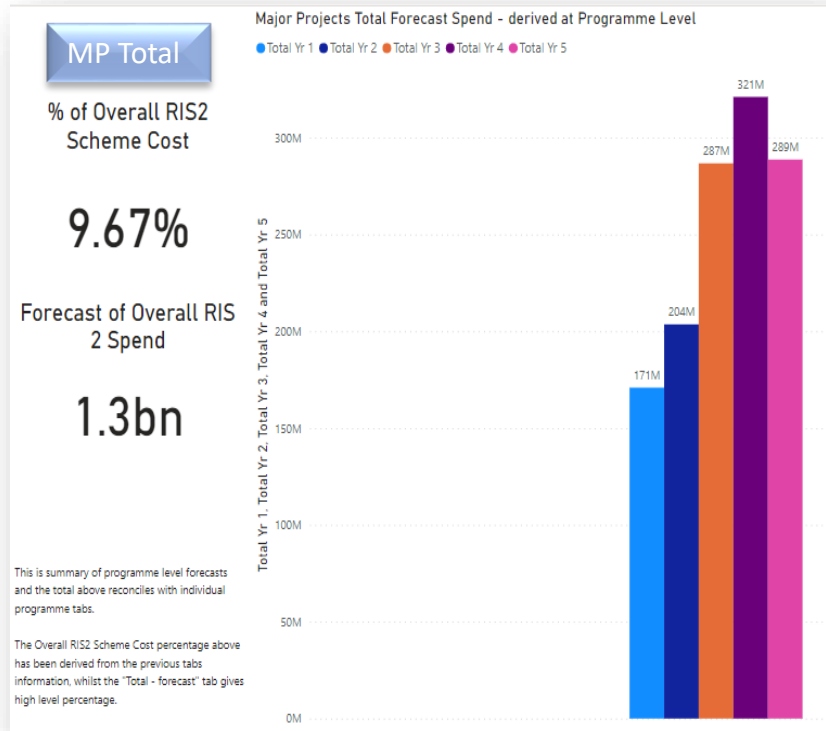
Conclusion:

Continue to monitor framework performance and identify incremental or alternate changes on a regional basis, aligning programmes to leverage volume demand and better manage and influence the market.

The map highlights who HE's current General Civils contractors are in Operations CWF framework, it is to be noted Earthworks does not have a specific lot earthworks are carried out under General Civils lot.



Future Forecast Spend



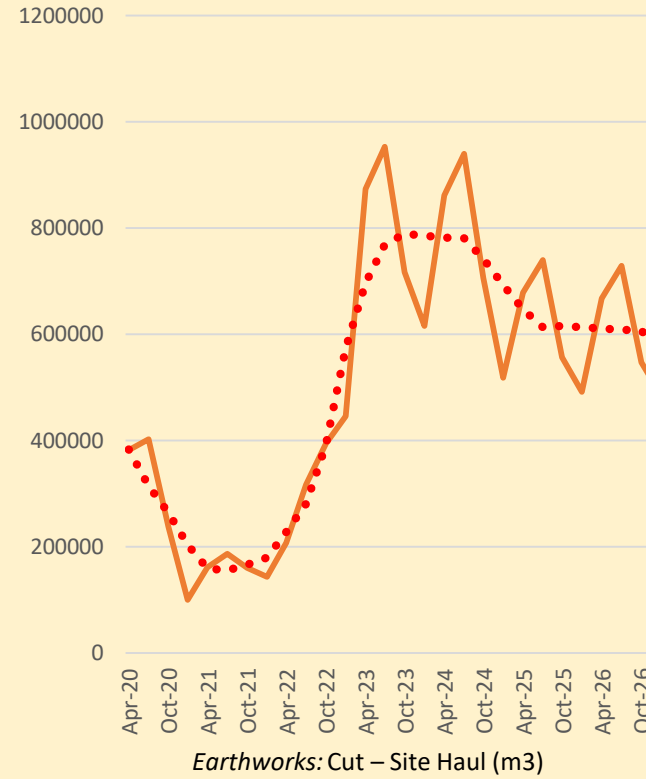
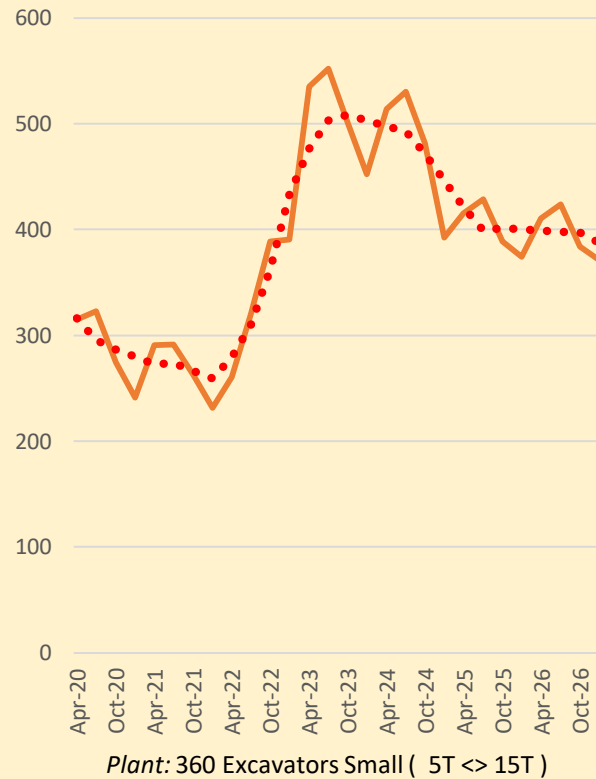
Conclusion:

- The value forecast is based on previous percentage spend against WBS elements from RP1 and the mid-point of RP2 assumptions then modelled against the current HE capital budgets for our investment programs. These figures will be reviewed and enhanced early in 2021 when Webcast data becomes available.
- Significant growth in expenditure in all delivery schemes with the exception of SMP spend declining throughout RP2
- These are MP only. Operations to be confirmed.
- Total spend RP2 1.3.1b therefore this category represents ~8% of the total spend (including LTC)

Plant and Earthworks demand data shows peaks in 2023 and 2024

Demand Side

- Both trend builds to middle of RP2 with Smart Motorway Programme.
- End of RP2 remains high due to Complex Infrastructure Programme pushing up demand.



Supply Side

- Increase in UK construction projects such as HS2, NWR’s CP6 will put constraints on the supply of plant and resources
- Lack of new technology digital plant operators
- Installation of digital corridors
- No consistent approach across HE programmes and schemes and reaction times takes too long
- An aging workforce within the industry which may lead to long term capacity issues with supply of resource
- Safety technology -the drive for safety improvement is at different pace between the supply chain and OEMs.
- Cost of investment of new technology and innovative solutions could be prohibitive
- No early engagement with contractors/subcontractors at design stage causing disruption to works in the main phase

Actions/Opportunities

- Visibility/tracking of resource forecasts and capacity are needed
- Better planning to resolve resource conflicts/shortages. (HS2 used CITB’s Labour Forecasting tool)
- Promote improved collaboration between suppliers and OEMs through community group meetings to promote safety and efficiency through innovation uptake

- Planning Managers to provide granular detail of labour and material requirements and cascade information to the business
- Early contractor involvement in the early planning and design stages
- Installation of digital 5G networks on all projects

Activity Analysis: Analysis of Value Chain Activities (Autonomous Plant)

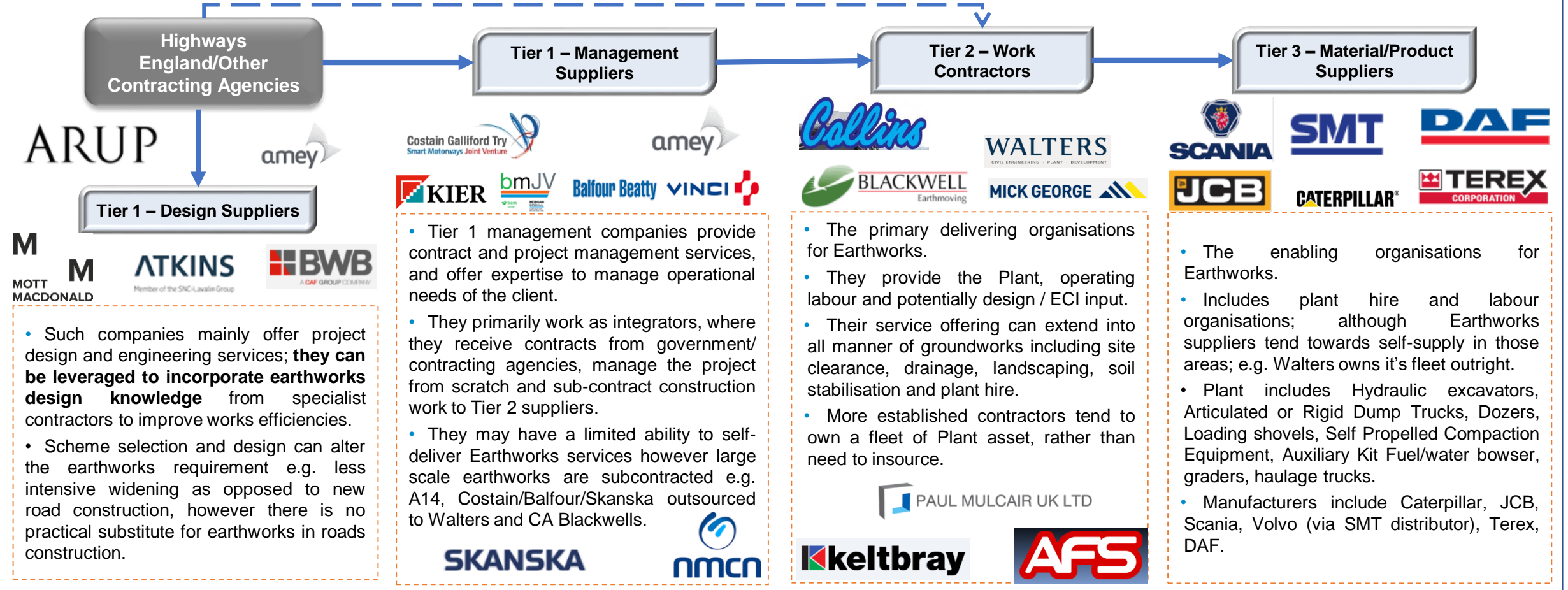
For each activity in the value chain, this analysis shows factors which we believe will add value, our current way of working, and changes needed to enable realisation of value at each step.

Value Chain	Value Factors	Current Situation	Changes Needed	
Needs & Requirements	Strategy	Accelerate availability of Autonomous Plant.	HE has successfully trialed Autonomous Dump Truck at A14 site.	Collaboration with SES Innovation.
	Safety	Reduced KSIs, as Autonomous machines potentially eliminate presence humans at site. Avoidance of VPF (Value of a Preventable Fatality) - £1.7 M Ref: True Value data base and £1M per week due to stand done at site.	HE implements all legal and Safety requirements. However human errors remain a threat.	Adopting Autonomous plant will potentially eliminate Human errors.
	Environment	Significant reduction in emissions due to reduced fuel usage.	Plant idling time is accepted as a norm impacting productivity	Adopting autonomous plant will eliminate Idling hours and will reduce fuel and maintenance. Hybrid system will save 40% fuel cost
Delivery Unit / Procurement	Plan to Adopt changes	Continuous engagements with manufacturers and other stakeholders will keep all at same level of information and progress.	HE SES Innovation decarbonization projects	Innovation consolidation and project alignment across the industry
	Consultation with Suppliers	Consultation with Suppliers will emphasize the seriousness of implementation. And suppliers will be probing manufacturers and this probing will cause acceleration at manufacturers end.	PEC Community engagements	Bridge between HE and wider market to remove any blockers such as legal or Financial
	Incentivization	Although Road Map has been launched with wide publication. To initiate / accelerate progress by suppliers / Contractors some form Incentives is required.	No Incentives on offer.	HE may offer sharing of savings (incentivise) by using Autonomous plant.
	Transformation of skills, New skills sets taking over	Opportunity to overcome shortage of skills, Which could be overcome by Transformation of skill sets of people who are relieved with introduction Autonomous Plant	There is Shortage of skills in various trades of construction Industry	HE may support in Transforming skill sets by investing in people through Tier 1 suppliers.
	Tender Terms Preparation	Revision and updating of Tender Terms as per new Legislation, regulations and Policy with regards to Autonomous plant	Revision of Legislation, regulations and Policy is at preliminary stage.	Understanding of changes required in terms of legislation, regulations and policy
Maintain & Operate	Sustain	HE will achieve all Financial and Non-financial benefits by successfully implementing and maintain the Road Map.	Road Map developed and shared with wider Industry and stake holders.	Wider Industry alignment of changes emerging in future

<i>Value factors are defined in terms of Highways England KPIs/Targets, which align to Strategic Themes</i>	<i>Value Factors (Highways England KPIs/Targets)</i>	<i>Highways England Strategic Themes</i>
	Safety (Network KSI and casualty reduction)	Safe & Serviceable Network
	Safety (Supply Chain Accident Frequency Rate reduction)	Safe & Serviceable Network
	Safety (HE Staff Accident Frequency Rate reduction)	Safe & Serviceable Network
	User Satisfaction	Customer Satisfaction
	Incident Management (Traffic Flow)	Free Flowing Network
	Network Condition	Safe & Serviceable Network
	Delivering Enhancements for Economic Growth	Supporting Economic Growth
	Environment	Improved Environment
	Efficiency	Delivering Performance & Efficiency
	Smart Motorways	Ensure Smart Motorways maintain safety and deliver journey benefits
	Employee engagement	Our People

Supply Chain Mapping – value and objectives

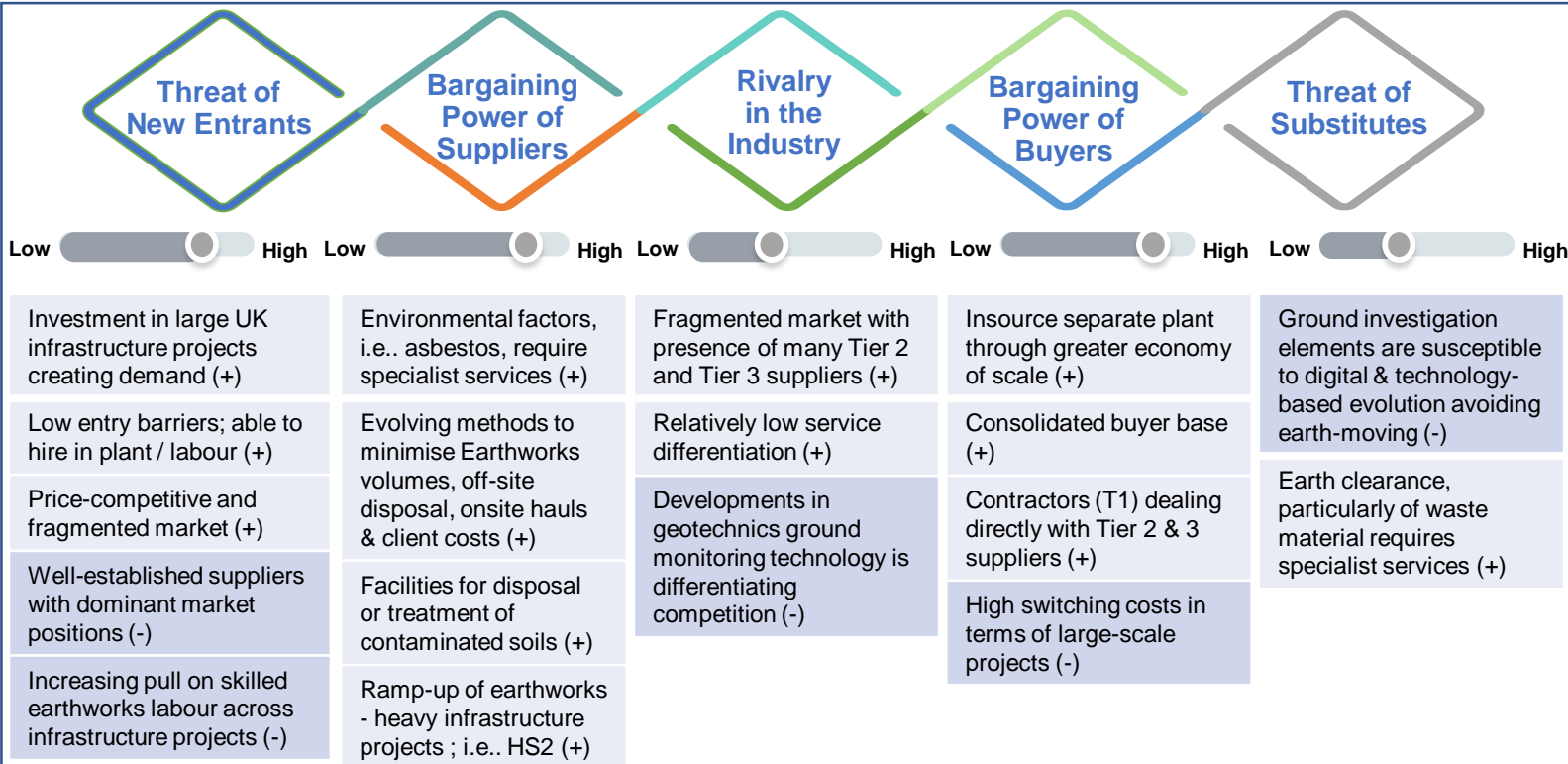
Earthworks are on the critical path of roads construction. Earthworks providers often offer design capabilities relevant to their specialism e.g. retaining walls, as well as supplementary services such as soil stabilisation (allowing the ground to take greater loads)



All Highways England's Earthworks have been procured at a subcontractor level by a Management Supplier. Major suppliers include CA Blackwells, Mick George, Paul Mulcair UK and Walters.

Market Insight and Landscape

- The UK Earthworks market is fragmented with presence of a large number of players, which can be classified into Tier 1, Tier 2 (who dominate the market) and Tier 3 suppliers.
- Tier 2 suppliers are mainly mid-sized companies that offer a variety of services including advisory, general civils, soil stabilisation, haulage and plant hire – this is where the principal Earthworks contractors operate.
- Most Tier 2 suppliers have local/regional presence, with limited companies having national presence
- Operating earthmoving equipment, requires technically skilled labour, trained for operating such equipment. Therefore the market can be negatively affected by resource capacity and capability pressures.



Conclusion: The marketplace is dominated by <5 more established suppliers who own their own plant; but increasing demand from greater UK investment in infrastructure projects is likely to constrain workforce capability and capacity.



Supplier Engagement: PEC Workshop

PEC Community Workshop Representation					
Balfour Beatty	Bomag	Effiag	Flannery	M O'Brien Group	Skanska
C A Blackwells	Caulfield	GAP Group	JCB	SMT (Volvo)	Sunbelt Rentals
CAT	Collins	Leica-geosystems	Komatsu	SC Sustainability School	
Content with Media	Costain	Mick George	MJ Church	Topcon	
Walters	K Rouse	SITECH UK.	Trimble Civil	Wacker Neuson	

Topic	Question	Key Feedback
A Safer Network	How can we influence safety including references to innovation, new products and the availability of new technology?	<ul style="list-style-type: none"> Consistent approach across all HE schemes and programs - reaction time to trials takes too long. Need an understanding of jobsite Wi-Fi/cellular coverage and if there is going to be a regulation per new project?
Improving Customer Satisfaction	How can we influence customer outcomes by improving time to deliver, reducing maintenance, improving efficiencies etc?	<ul style="list-style-type: none"> Use the technology available to today (pay for it) and understand whole life cycle cost. Early understanding at design stage and DCO stage in approach. Public/Air quality
Delivering RIS	How can we improve delivery for HE or provide faster or better outputs, whole life cost, value etc.?	<ul style="list-style-type: none"> Value has to be key, not price. Bids for contracts have to be compared and be compliant and judged on experience, plant capability and also previous performance.
HE Engagement	Advise on areas where HE should consider improving within the supply chain and advise possible solutions	<ul style="list-style-type: none"> We should expect the client to scope the technology because this is understood to be "required". Outcome based specification over minimum standard. (unless a specific business case is provided)
Current and Future Business	What are the major risks and also opportunities that you see within your business sector?	<ul style="list-style-type: none"> Huge lack of plant operators, digital plant people. remote operator adoption Scale of capex required to keep pace with rate of change in digital and renewable areas; client willingness to support investment decisions with longer term hire/lease commitments.
Innovation	What innovations can/should be implemented (short term) and if not already done so why?	<ul style="list-style-type: none"> Use the technology available - semi-auto excavators/ intelligent compaction etc
Carbon Net Zero	How are you engaging with manufactures/suppliers/each other to achieve zero carbon fleets?	<ul style="list-style-type: none"> Early adoption of new technology in order to contribute feedback and help further the innovation and development of these technologies to make them better, more efficient and long term mass produced therefore more affordable. Short term pain, long term gain Low/zero carbon fleet; battery/solar/hydrogen alternatives available; on site manufacture of hydrogen;

Supplier Engagement: Focus on 3 Key Imperatives: Safety Customer and Delivery.



Earthworks Community Workshop Feedback - December 2020	Short term	Medium term	Long term
Delivering RIS: How can we improve delivery for GE or provide faster or better outputs, whole life cost, value etc	Early engagement and scope expectations Long term partners Engagement of technology available now and tomorrow	Value not price Compliant bid process Low technology adoption rate	Environmental, space constraints, trades, site traffic Split shift working Contra flows
Improving Customer Satisfaction: How can we influence customer outcomes by improving time to deliver, reducing maintenance	Use of technology and early engagement Cost implications Learn from other countries	Managed KPIs and productivity Connect site and client Improve productivity, plant uptime	New roles, digital managers Realistic project timeframes Technology adoption
A Safer Network: How can we influence safety including references to innovation, new products and the availability of new technology	Knowledge sharing. Showcase success Understand what industry is willing to try and test	Consistency and OEMs slow to change Understanding culture differences Understanding project plants for WIFI coverage	Manufactures need to drive change Safety starts with operators
Carbon: How are you engaging with manufacturers/ Suppliers/each other to achieve zero carbon fleets?	Training /education sustainability schools BIO fuels, investment in electric (battery /solar) Increase cost of purchase/investment Become less competitive	Adoption of technology Long term mass production more cost effective Investment required	Fuel targets and options Battery /solar /hydrogen alternatives available Onsite manufacture of hydrogen
Current and Future Business: What are the major risks and also opportunities that you see within your business sector	Lack of digital plant operators Significant capex investment requiring long term agreements Adoption rate of technology	Lack of digital plant operators Require skills and training	Lack of digital plant operators Tiers 2 as head contractor
HE Engagement: Advise on areas where HE should consider improving within the supply chain and advise possible solutions	Client scoping technology requirements Outcome based specifications Consistent approach across schemes and programmes	Changes in tender process (technology outcome based) Realistic timeframes Longer lead times	Community representation to HE Early engagement Realistic timeframes of projects Provide R&D technology funding
Innovations: What innovations can/should be implemented (short term) and if not already done so why?	Machine data Client dashboards Use of available technology	5G networks autonomous plant Remote control Investment required	CAP 2035

- The workshop was attended by representatives from tier 1, tier 2 and OEMs. Breakout sessions to discuss and obtain feedback on 7 key areas with a focus on the short, medium and long term objectives.

Supplier Engagement

- The Earthworks survey questionnaire was sent to 34 suppliers which included a broad range of Tier 2's which included specialist earthwork suppliers, general civil engineers, plant hire companies and manufacturers of plant and equipment.
- Some of the suppliers were identified on HE's Project Bank Account System from RIS 1, others were either from existing working knowledge and new potential suppliers were researched on online business platforms.
- The aim of this survey is to gain initial insight of the supplier's capacity and capabilities and to achieve an understanding of characteristics, trends and issues currently within the earthmoving sector. The survey was sent via Microsoft Forms and the questions comprised of multiple choice and open-ended questions.
- The Table below are examples of some questions asked. The table on the (right) are the suppliers who replied to the survey. Feedback can be seen in the next slide.

Sample of some of the questions to get gain insight into their organisation and the sector they operate in

- In which area(s) is your expertise?
- In which capacity do you operate – local/regional/ national
- Please select your most competitive areas –North West/Yorkshire and North East/ Mids/East/South East/South West
- What type of machines and equipment do you have in your fleet?
- In which areas could improvements be made to make HE a desirable customer?
- What elements of your overall earthworks service is subcontracted? Can you please name them?
- Which earthworks suppliers do you feel have the biggest presence in the UK?
- If you work on Highways England network who are you contracted through ?
- In relation to plant or equipment please indicate which recent investments/ innovations have you made to better deliver your service?
- Do you believe you have any innovative products or working methods which you think Highways England and the supply can benefit from and would you like to discuss with Highways England?
- The UK infrastructure industry is facing a well documented problem with an ageing workforce. Has this affected your business and what plans have you implemented to address this issue?
- Over the last 5 years, have you lost any specific skills that are difficult or costly replace?
- Do you think earthmoving supply base is competitive? (please elaborate)
- Which certificates do your operators hold?
- Have you signed up to the Health and Safety passport scheme?
- What challenges have you faced with Covid-19?

CA Blackwell	
MJ Church	
Mick George	
JC Balls & Sons	
Ovenden	
AFS Earthworks	
Whitnell Contractors	
K Rouse	
Montel Civil Engineering	
Erith Contractors	
ACS Civil Engineering	
Hall Construction	
Kane Group	
Trimble Inc	
SMTGB/Volvo	
Mabey Hire	

Key

- Earthwork Specialists
- General Civil Engineering – (inc earthworks)
- Manufactures
- Plant Hire

Supplier Engagement



Summary of Feedback- Earthworks Survey

Top 3 Key Pain Points

- Tier 2's see the current procurement process as one of their top pain points
- Lack of ability to influence design at early planning stages
- Tier 2 said volume of work with HE needs to be increased

OEMs said they want opportunity to collaborate on innovation with HE

Tier 2 expressed they are not given the opportunity for early contractor involvement (ECI) to add value to the project

<p>Procurement</p> <ul style="list-style-type: none"> • Tender process needs to change with more realistic timeframes for contracts to be carried out • Tier 2 feel they are at the lowest end of the supply chain end up with most risk • Level playing field during the quotation and contract period is critical to company performance need to be considered with less reliance and weighting to lowest price 	<p>Operational Maintenance</p> <ul style="list-style-type: none"> • Ability to influence planning • Need for realistic time frames for the works to be carried out safely and to specification and further to ensure that there are zero defects, therefore reducing maintenance. 	<p>People</p> <ul style="list-style-type: none"> • Concern surrounding aging workforce in in the sector • huge lack of plant operators and digital plant skilled people • There is an unwillingness to allow young experienced people on site; apprentices and training the young is essential • Earthworks skills are learned on the field but there is a diminished demand skill depleted in a specialist industry
<p>Commercial</p> <ul style="list-style-type: none"> • Tier 2's not offered target cost options but placed on re-measurable contracts whilst Tier 1 are on target cost; resulting to more risk placed on Tier 2's 	<p>Innovations</p> <ul style="list-style-type: none"> • Levels of technology adoption is still showing some low levels considering the whole project life cycle • Consistent approach across all HE programmes reaction time to trials takes too long 	<p>Standards and Design</p> <ul style="list-style-type: none"> • Design is very hard to improve and influence • Early involvement is key/critical for best effect and to avoid design stage remodels and redesigns

Conclusion:

- **Opportunities** - Early contractor involvement is key factor in the success of a project but also to mitigate re-design, project delays and disruptions in the main phase of works.
- **Efficiencies** - Predictability of workload is the key driver to earthworks efficiency, as the equipment capital investments required outlive the life of a single project
- **Risks**-Communication and planning- unrealistic time frames to deliver work by tier 2's is concern leading to safety risks. Commercial terms and conditions in favor of the tier 1's. Supplier engagement suggests a gap in communication between manufacturers and suppliers with regards to technology adoption and OEMs not driving the change leading to technology rate bottlenecks in adoption. Suppliers want to be taken on a journey with the OEM. Suppliers feel manufactures do not understand their culture
- **Challenges** – The procurement processes driven by lowest price without regard to skills and capability. Too orientated to the larger national providers with a disregard to local contractors. For tier 2 suppliers there are challenges around overly in-depth procurement process



Category Analysis

Strengths

- Commitment to safety and sharing best practice
- Collaboration between Suppliers and OEMs through Community Group Meetings Geographical supply chain coverage
- Raising the Bar (safety)

Weakness

- Environmental, space constraints, trades, site traffic
- Over reliance on frameworks
- Weather - dependency (work spring to autumn)
- Total value as opposed to lowest cost
- Lack of influence on Tier 1
- Specialist Engineering Contractors' (SEC) Group is being disbanded.

Opportunity

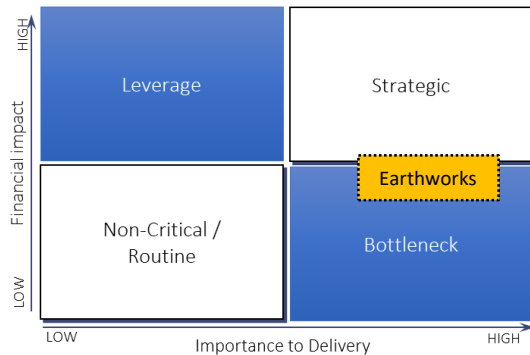
- Implementation of 5G and WIFI coverage
- Early contractor involvement in the early planning and design stages
- Consistent approach across schemes and programmes
- Fuel targets and options
- Battery/solar/hydrogen alternatives
- Plant uptime

Threats

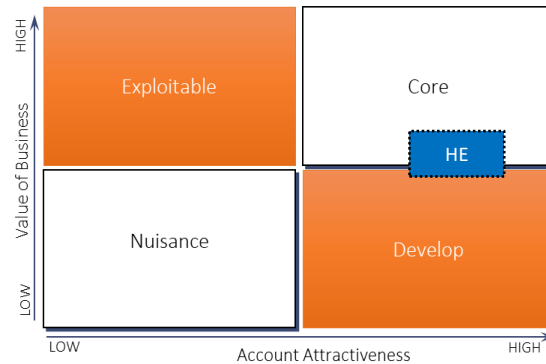
- Cost of investment in new technology
- Skills development and retention (digital managers)
- Economic uncertainty
- Increase in UK construction projects such as HS2, NWR's CP6
- An aging workforce and lack of plant and digital plant operators

PESTLE	Developments	Significance H/M/L
Political	• Government policy and future project(s) approval	M
Economic	• Industry cost factors (Oil, materials, equipment)	M
Social	• Ageing workforce and retention • Lack of new sector skills and apprentices for new technology. Re-training of employees with regards to new skill sets requirements • New technologies demand for new skill sets will increase and will compensate job losses	H
Technological	• Uptake in new technologies and innovative plant equipment • Cost of investment: CAPEX	M
Legal/Regulatory	• Health and Safety requirements • HE project sites will be off road and will not be subjected to Road and Traffic laws. Insurance laws may also require revision	M
Environmental	• Zero carbon targets • Autonomous and Hybrid plant will produce less emissions, which is inline with HE policy for Environment	H

Highways England Perspective



Supplier Perspective



Conclusion:

HE is still an attractive proposition for the supply chain market however limited supply options within the market coupled with increased demand will put a strain on availability.

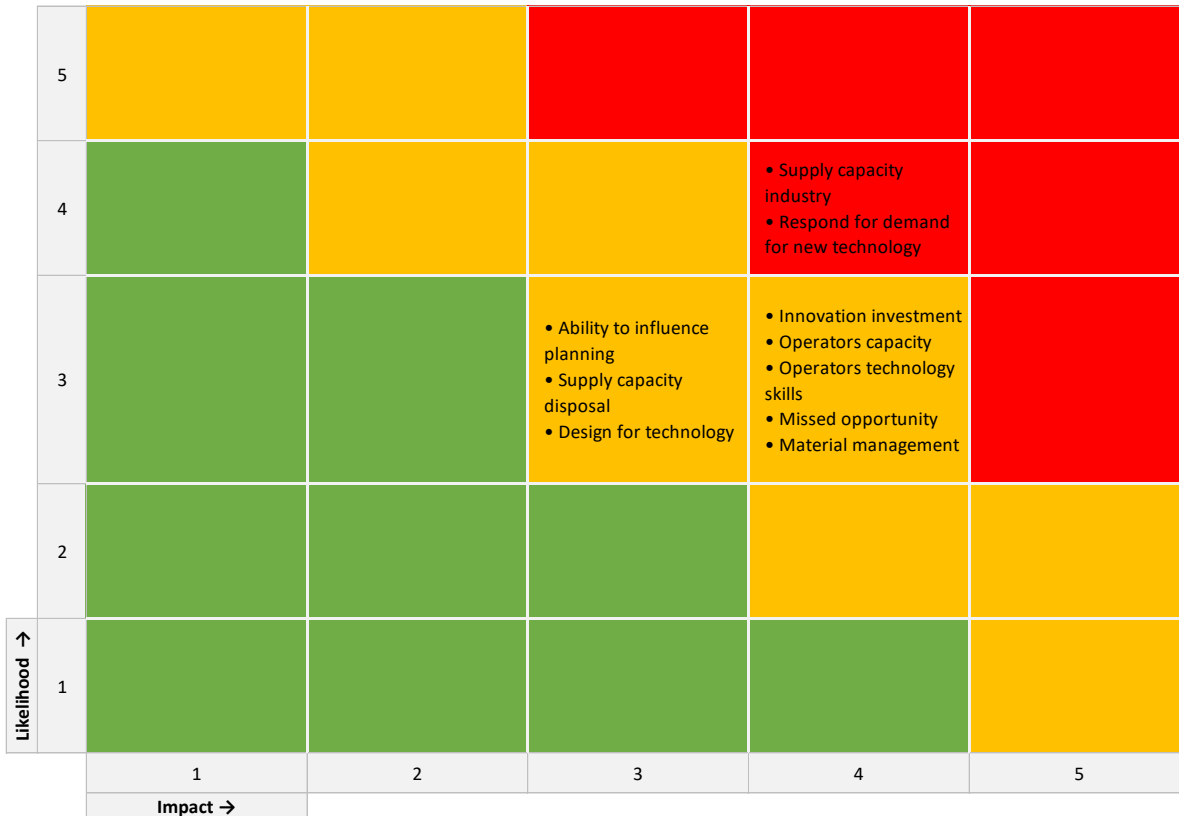
The supply chain already faces challenges in terms of workforce capacity and capability and with economic uncertainty around Brexit and the impact of Covid 19 long term investment required in innovation and new technology could be prohibitive

Key Supplier Risks

Risk type	Risk Description	Impact	Priority	Mitigation/Action
Supply Chain	<ul style="list-style-type: none"> While the market is less marginal than others (i.e. drainage), suppliers in tier 2 & 3 are exposed to financial deterioration if plant movements are restricted through Covid-19 practices. Market is dominated by several larger, more established suppliers – which suppresses the opportunity for SME subcontractors to gain a foothold and develop a broader base. 	<ul style="list-style-type: none"> Risk is largely mitigated by continuation of works, but will be susceptible to payment delinquency by Tier 1s. 	Medium	<ul style="list-style-type: none"> Enforce payment behaviours in primary client contract, enabling cashflow to be managed further down tiers. Encourage collaboration of more established suppliers with SMEs to develop increased understanding of HE's requirements & influence opportunities to work directly.
Innovation	<ul style="list-style-type: none"> Contract terms given by Tier 1 to contractors in lower tiers often do not mirror client (HE), with risk pushed down & discouraging innovative approaches from being developed. Opportunities to engage early at design stage are minimal, meaning that works are at risk of being aborted or revised at increased cost & time if geotechnics design principles are not considered at the outset. Commercial interests in maintaining manual earth-moving practices do not encourage greater innovation through technological advances. 	<ul style="list-style-type: none"> Risk averse supply chain promoting little development. Avoidable abortive work by not factoring in ground conditions, increasing cost & time. Opportunities for cost, process & time efficiencies are missed. 	High	<ul style="list-style-type: none"> Enforce contract requirement to pass contract benefits to ensuing supply chain, maintaining pain/gain principles. Include earthworks supply chain in early design considerations in order that geotechnics aspects are factored into key decisions. Incentivise innovation in the framework to provide clear financial encouragement to seek more effective ways or working.
Capacity	<ul style="list-style-type: none"> Increased investment by UK Government in large infrastructure projects, such as HS2, is placing a resource and plant constraint on the market. Limited interconnectivity with other delivery suppliers to find better sequencing of works activities & shared benefits. 	<ul style="list-style-type: none"> Lack of skilled resource & plant available. Inefficient deployment adding to time & cost. 	High	<ul style="list-style-type: none"> Government level visibility of competing demands to co-ordinate resource requirement & avoid pinch-points. Adopt a works 'community' where suppliers on the scheme can actively engage & collaborate as the works progress.

Conclusion: Pre-emptive measures by Highways England when setting out the contract documentation and over-seeing contract compliance will deliver more effective supplier outcomes and greater work efficiency.

Risk Map



Title	Risk Description	RAG
Innovation investment	Cost of investment in new technology	A
Operators capacity	Ageing workforce, skills development and retention	A
Operators technology skills	Lack of plant and digital operators	A
Supply capacity industry	Increase in UK construction projects	R
Ability to influence planning	Ability of the market to respond for demand for new technology	A
Respond for demand for new technology	Lack of consolidated program and community collaboration	R
Supply capacity disposal	Forecast supply capacity issues for material disposal	A
Design for technology	Reluctance to design for machines	A
Missed opportunity	Collaboration of enterprise agreements	A
Material management	Uptake of alternate material management techniques	A

Strategy - Short to Medium Term

Procurement Strategy	Description	Benefit	Action
Carbon Net Zero	<ul style="list-style-type: none"> Targets and implementation roadmap 	<ul style="list-style-type: none"> Define HE requirements and expectations Establish alternate sources of supply Incentivise the supply chain to be proactive (TCO) Clear guidance and expectations of delivery Supply chain time to plan and invest. 	<ul style="list-style-type: none"> Establish supply chain options and plans for environmental sustainable solutions
Planning and Design	<ul style="list-style-type: none"> Design for machines process and implementation 	<ul style="list-style-type: none"> Utilisation and cost control of machinery aligned to scope of work Maximise the planning, productivity and efficiency gains and support operations on site machine interfaces. Currently no specification for “design to machines. The design community and the Plant and Earthworks Community to solve this together (buy in from Trimble/Leica/ Topcon) 	<ul style="list-style-type: none"> Project workshop with PEC including Trimble/Leica/ Topcon
Project Alignment	<ul style="list-style-type: none"> Enterprise alignment agreement Potential to utilise on the A66 	<ul style="list-style-type: none"> Maximise productivity and efficiency 	<ul style="list-style-type: none"> Engage NRDPSLG (North RDP Senior Leadership Group)
Training and Development	<ul style="list-style-type: none"> Support the development of training facilities Encourage social value 	<ul style="list-style-type: none"> Support technology developments and implementation Mitigate future skills and capability requirements Deliver on social value 	<ul style="list-style-type: none"> PEC and Supply Chain School

Strategy – Long Term

Procurement Strategy	Description	Benefit	Action
Material Management	<ul style="list-style-type: none"> • Circular economy and sustainability and environmental sustainability project • Utilising the carbon tool 	<ul style="list-style-type: none"> • Reduction in waste materials, transportation and landfill and reduction in carbon (reduce, reuse, recycle) • Tracking waste • Carbon tool in resource efficiency • Internal and external excavated materials, including soil • Aggregates – mapping from quarry to end of life • Consider carbon in economic appraisals • Utilise HE Carbon calculation tool to enhance decision making 	<ul style="list-style-type: none"> • Major Infrastructure–Resource Optimisation Group (MI-ROG)
Innovation	<ul style="list-style-type: none"> • Decarbonisation of construction plant project (innovation) • Alignment on CAP (connected and autonomous plant), PEC (plant and earthworks community) and SCS (supply chain school) innovation and technology developments 	<ul style="list-style-type: none"> • Remove man/machine interfaces and improve safety • Optimise plant movements and improve cycle times • Contribute towards our carbon net zero target. • Reduced environmental impact • Reduce waste (time, money and effort) • Increase speed of implementation • 3D Machine control productivity gains • <i>(Alignment with general plant and equipment strategic procurement strategy for environmental sustainable equipment solutions).</i> 	<ul style="list-style-type: none"> • Innovation SES Decarbonisation Plant Project

Recommendations

Benefits Strategy	Description	Recommendation
See Strategy - Short to Medium, Long Term slide	See Executive Summary –slide	<ul style="list-style-type: none">• Approval of strategic procurement strategy