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Capital Projects in the Digital Age

The Capital Project of the Future

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EXECUTIVE SUMMARY

Harnessing emerging technologies and building a digital capability can help take Capital Project delivery and operations to new frontiers of efficiency and control to foster market-leading performance.

- The Capital Projects industry has historically **underinvested** in technology and has been resistant to change.
- There is an opportunity to use **technology to leverage** delivery and the potential to achieve operational savings.
- We are in a **"golden age"** of technology where advancements in finance platforms, internet based sensor technology, unmanned vehicles, cloud based solutions and analytics capabilities are converging to provide a paradigm shift for Capital Projects, creating real opportunities that industry players can capitalise on right now.
- This document highlights particular technologies which we see making a real impact on how Capital Projects of the future may be delivered and the specific impact they are expected to realise. Also, it provides a view of steps organisations can take to plan and develop long term digital strategies to facilitate adoption of cutting edge technologies and embed digital trends.

THE OPPORTUNITY

In general, the Capital Project industry has not changed significantly in the last 50 years and appears to be burdened by legacy processes and inefficiencies, making it ready for a technological upheaval.



HISTORICAL UNDERINVESTMENT IN TECHNOLOGY CAPABILITY

In our experience, we believe that the Capital Projects industry has historically underinvested in technology and seems to be resistant to change. It has largely been based on high volumes of disparate and unstructured data. We believe there are therefore significant benefits for those who invest wisely now.



FRAGMENTATED SUPPLY CHAIN WITH NO INCENTIVE TO DIGITISE

In our view the entire Capital Projects supply chain has traditionally been based on misaligned commercial objectives and incentives, with owners apparently more interested in meeting proformas and schedule, the contractors interested in profit.



TECHNOLOGY PRESENTS A SIGNIFICANT BUSINESS VALUE OPPORTUNITY

Leveraging technology in the planning, delivery and operation of Capital Projects presents a potentially significant business value opportunity. Therefore when determining the key success criteria for any Capital Projects in the future, the development of digital capability should be considered.

THE FUTURE CAPITAL PROJECT

Technology can enable Capital Projects to achieve new speed and efficiency; a project "superhighway."

THE ENABLERS



1 Data driven project planning and execution



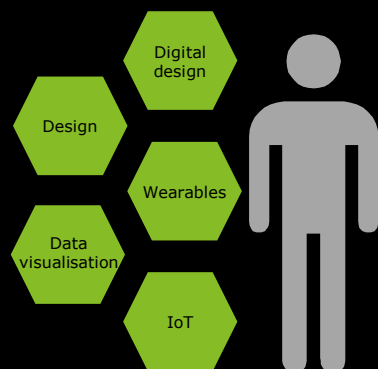
THE PROJECT SUPERHIGHWAY

Substantial increase in design speed

Project delivery speed increased

Lower risk profile and cost

Our experience indicates 1.5% Capital Delivery savings and up to 20% asset maintenance cost reductions over the asset lifecycle



2 Augmented workforce with new capabilities

DELOITTE'S CAPITAL PROJECT FRAMEWORK

Leveraging digital technologies, Deloitte can help our clients capture business value across different dimensions in the various stages of the project lifecycle, from strategy and planning through to decommissioning.

Capital Projects

Through our capability in digital and technology we have seen the world changing across a range of sectors. By applying our Capital Projects industry experience, we recognise the opportunity that digital and technology present in this sector.

We believe Capital Projects which exceed \$1Bn in value such as airports, rail and major events require organisations to be setup in a similar way to FTSE 250 companies. These projects should have the structure, governance and technology in place that any organisation managing this turnover would require.

What we have seen

The use of technology has become an enabler in collecting, structuring and integrating information for more efficient delivery and operations in Capital Projects. For example the use of Integrated Project Analytics, Visualisation tools and Digital mobility are all technology solutions that have started to emerge as mainstream requirements in the Capital Projects environment.

The Opportunity

Our experience indicates that, as a result of a risk-averse culture, the Capital Project industry may not be capitalising on the pace and change in technology and has only marginally adopted new and innovative ways of working. There are still several of areas of business value that Capital Project clients may realise by adopting a forward looking digital strategy for their projects.

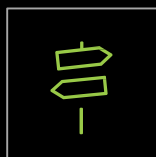
Deloitte is a market leader in consulting clients in the Capital Projects Industry and Technology realm with the experience to help clients realise the opportunity from their digital capability.



This Point of View explores the technologies that are touching the Capital Projects industry and looks at what clients can do now to integrate the technology capabilities enhancing the industry. It looks at the areas of business value, against the Capital Project lifecycle, that clients should consider in order to help realise short and long term benefits.

GETTING THE BASICS RIGHT

Even without considering the value that the latest technology trends can bring, there are a number of things that Capital Project and Infrastructure Asset organisations could be doing to enhance efficiencies.



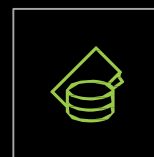
Create an overarching data and technology strategy with a roadmap to future technology adoption.

An integrated strategy considering potential benefits from current and future technology assists with efficient investment to support the full lifecycle of a Capital Project.



Invest in current technology and data management capability to maximise business value opportunities.

Introduction of appropriate technology and development of capability to analyse gathered data will enable meaningful insights can be achieved that have the potential to add value.



Organise to make improvements around insights from data analytics.

Ability to react to insights with appropriate governance in place to make quicker decisions enables the benefits of identified opportunities to be maximised.

KEY EMERGING TECHNOLOGIES

Harnessing emerging technologies and building a digital capability can take Capital Project delivery and operations to new frontiers of efficiency and control to help deliver market-leading performance.



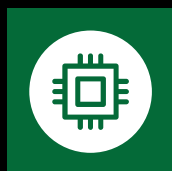
Wearables

Wearable technology is pioneering a way to make on site communication, document work management, real time support and asset data capture more efficient and safer.



Drones

Drones are proving useful for various applications such as collection of construction data via aerial images and 3D models, tracking of progress and or weather events, and health & safety assessment prior to workforce mobilisation.



Analytics

The analysis of big data sources to identify key drivers for improved safety and delivery efficiency of Capital Projects.



Platform as a Service (PaaS)

The provision of programme controls capability and technology solutions as a cloud-based integrated platform, reducing the need for large technology solution investment costs.



Blockchain

Technology that allows parties to trust a shared record or ledger. It can streamline business processes and establish transparency, trust and accountability, allowing value to be tracked and transferred without third party mediation.

VALUE TO BE REALISED

Embracing emerging technologies on Capital Projects can add value through a reduction of cost, risk and time.

The following are examples of how even just two emerging digital trends can add value to a Capital Project:



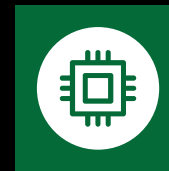
Platform as a Service (PaaS)

Removal of capital expenditure. The use of a cloud based integrated platform can significantly reduce the upfront investment of multiple software packages. Cost distribution across the life of the project also mitigates the risk associated with high initial capital expenditure.

Cost Efficiency. PaaS solutions can be scaled to the project to avoid the cost of software solutions that are more complex than required.

Increased flexibility and variability. High flexibility of a PaaS solution offers more rapid scalability to meet the changing demand of a project with lower risk of over committing resources.

Reduced interface complexity. PaaS reduces the interface complexity experienced with traditional use of multi-software solutions, reducing IT resource requirements.



Analytics

Greater clarity of spend, performance and utilisation efficiency. Advanced information management and visualisation solutions integrate information for greater transparency. This enables enhanced insight and faster decision making capability to support continuous improvement throughout delivery.

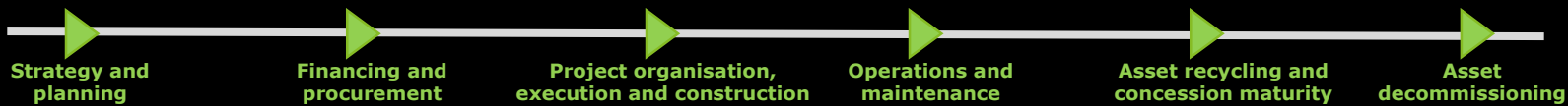
Reduction in unnecessary spend on infrastructure renewal. Advanced analytics can be used to predict when a machine / infrastructure might fail, allowing for more efficient maintenance routines.

Based on our experience with technology delivery on multi-billion pound infrastructure programmes we expect to see:

- **Cost savings of up to 1.5% Capex** using these technologies. This is based on expected 10% reduction in contingency spend (typically 15% of total project cost).
- Integration of asset information into a full life operations and maintenance system during the design process.
- Inclusion of infrastructure condition sensors to facilitate real-time analytics on assets to optimise performance.

HEALTH & SAFETY

Using technology to direct and protect people involved in Capital Project delivery and operations.



Wearables & Near Field Technology (NFT)

Biometric monitoring enables key information to be monitored helping to prevent incidents and enable tracking in emergencies. e.g. of remote workers or critical machinery operatives; location during evacuation; contamination exposure; paint that can be GPS located on high-vis jackets. NFT can be used to alert plant operators to workforce nearby.

Deloitte Case Study:

Deloitte is collaborating with several players in the UK construction industry in trialing wearable wrist band technology, where contractors monitor access and vital health metrics of work force on site.

Remote vehicles e.g. drones

These can be deployed for site inspection in hazardous situations (environmental and physical) prior to, or instead of mobilisation of workforce. This can eliminate workforces exposure e.g. Visual inspections on the underside of bridges.

Applied Example¹:

Network rail is understood to use drones for infrastructure inspections and land surveys. This reduces the risk to a workforce that often have to work at height or in close proximity to the railway to carry out inspections.

Smart hard hats and glasses

Used to provide two way communication, including real time provision of information to operatives, task support and contextual information e.g. team location.

Deloitte Case Study:

Lens by Deloitte is a multi-device, smartglass solution that provides field service workers hands-free access to contextual, real-time information. Field activities can be carried out with the provision of hands-free handbook information, and remote assistance.

Applied Example²:

Daqri has worked with Hyperloop Transportation providing a Smart Helmet that gives on-demand support to more remote workers allowing tasks to be completed quickly, correctly and safely first time.

Health & Safety

Self-organising analytics

Analysis of big data sources to identify key drivers for improved safety and efficiency of delivery of Capital Projects.

Deloitte Case Study:

- A self-insuring company was seeking to improve its safety record and gain a deeper understanding of the key cost drivers behind work-related injuries.
- A Safety Analytics project was completed to identify key drivers of work place incidents in order to focus safety resources and planning where they will have the most impact
- Client projected reduction in frequency of 15% for top six loss causes and 8% for all causes

POTENTIAL BUSINESS VALUE:

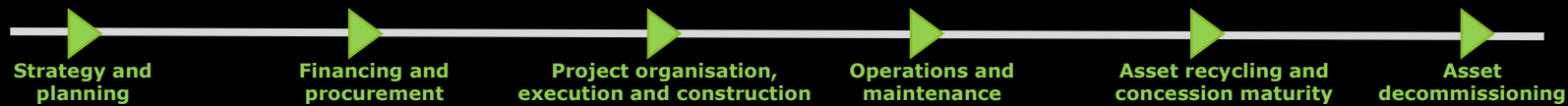
- More efficient / real time safety information
- Reduced near misses and safety incidents
- Easier warnings and safety contingency planning capability
- Trend analysis to better understand conditions for incidents, giving improved ability to manage safety
- Healthier, happier and more productive workforce

CAPABILITIES REQUIRED

- ✓ Data Analytics capability
- ✓ Defined Processes & Standards
- ✓ Data Quality & Governance

COST

Using Technology to target the fragmented supply chain and minimise intermediary costs.



Crowdfunding

Consideration of alternative internet enabled funding options.

Applied Example³:

Crowdfunding platforms such as Fundrise (US) and Property Crowd (UK) have been known to offer investment opportunities in real estate projects.

Blockchain Finance

Use of an authenticated audit trail to assure compliant payment to supply chain – key in open book contracts.

Deloitte Case Study:

Blockchain Labs

- Delivery of labs to assist clients in understanding opportunities to leverage the technology.

Blockchain Application Development - Rubix

- Rubix by Deloitte is an industry leading blockchain application development team that support developers in creating and deploying applications customised for unique industry and client needs.

Automated Back Office Functions

Standard, repeatable activities such as auditing employee expenses, timesheets etc. can be delivered by an intelligent software, potentially reducing costs and increasing accuracy.

Applied Example⁴:

Telefonica O2 have implemented Robotic Process Automation for back office functions with significant return on investment (3 year ROI >650%) driven from increased process efficiency.

Asset-linked financial decisions

Using asset information to inform Capex and Opex decisions and forecast spend profiles.

Deloitte Case Study:

Deloitte assisted a transport infrastructure organisation to optimise their capital investment in network infrastructure by implementing predictive asset maintenance tools reducing unnecessary expenditure.

Project Controls – Software as a Service (SaaS)

Capital Projects often require short term sophisticated licences for project controls; these can move to managed services saving money and setup time.

Applied Example⁵:

Established engineering software providers such as McLaren Software are offering new cloud based solutions for Programme Controls (Schedule, Cost, Risk, Contract Management) reduce software cost and time to implement.



POTENTIAL BUSINESS VALUE:

- Capex savings on Construction Design and Delivery (BIM)
- Opex savings through use of Enterprise Asset Management (EAM) Technology
- Opex savings due to automated business processes



CAPABILITIES REQUIRED

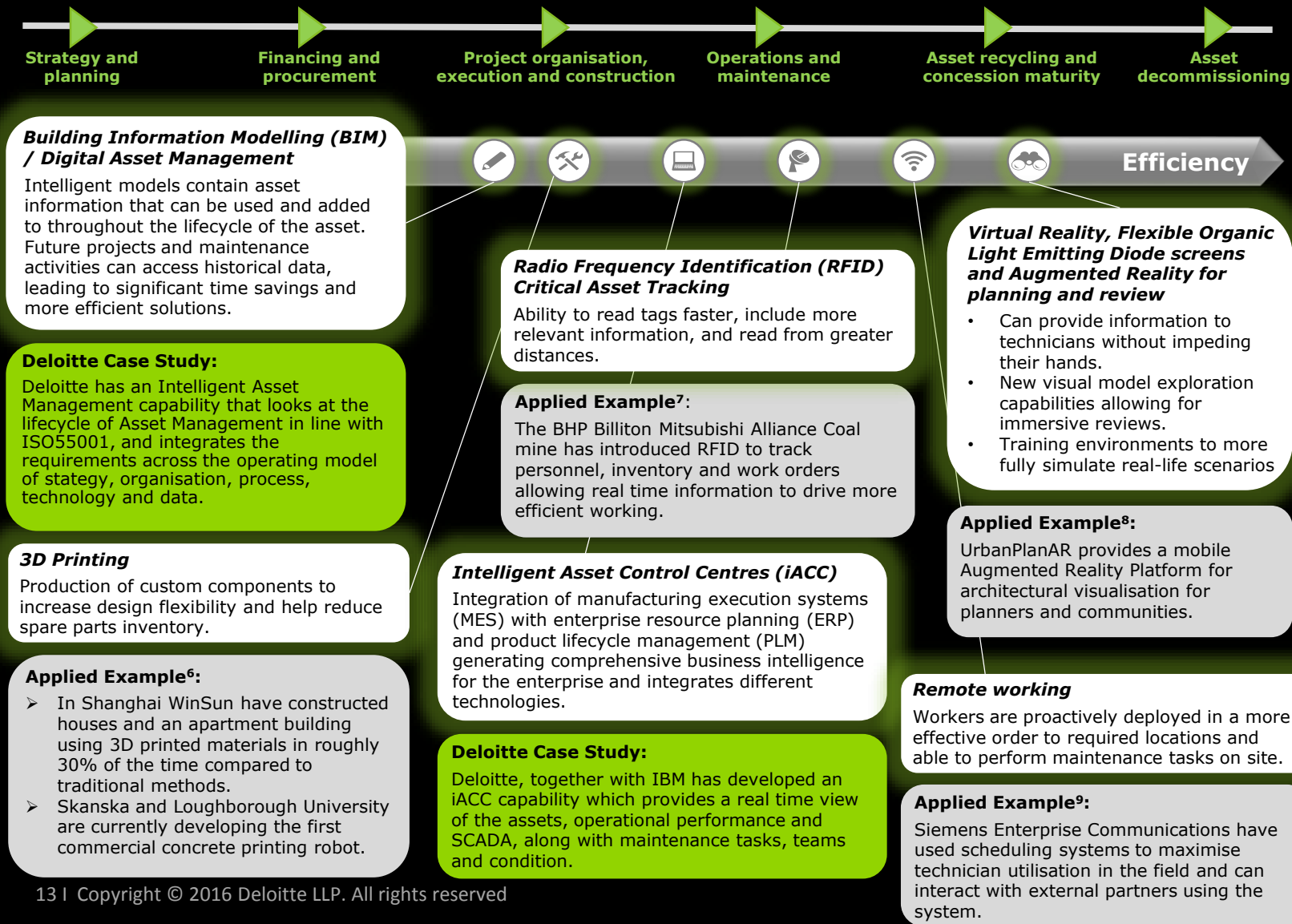
- ✓ End to end Processes, Programme Controls Governance & Standards
- ✓ High levels of Asset Data Quality & Governance
- ✓ Client technology competency



TIME

Capital projects are incredibly complex to manage and oversee. In 2015 31% of construction projects came in over budget and 60% were completed late.¹⁰

Using technology to improve capital delivery and operational efficiency.



POTENTIAL BUSINESS VALUE:

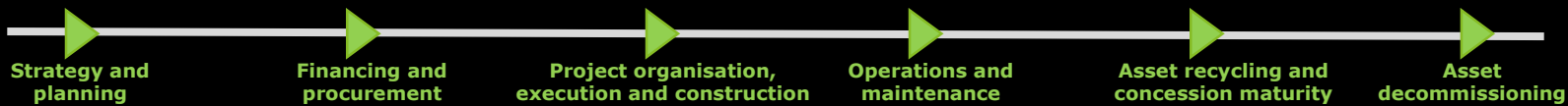
- 5-10% delivery time efficiency through use of BIM
- Time and cost savings for not having to look for or pay for extensive research or re-surveying of existing asset data at handovers
- Efficient and better informed business decisions through clearer visualisation

CAPABILITIES REQUIRED

- ✓ End to end Processes, Intelligent end to end Asset Management Strategy
- ✓ Asset Analytics & IT/OT capability
- ✓ Defined Processes & Standards
- ✓ Asset Data Quality & Governance

RISK

Using technology to enhance risk assessment while potentially reducing delivery and operational risk.



Cyber Security

Cyber protection of information critical to physical security and protection of commercially sensitive data.

Deloitte Case Study:

Deloitte assisted an Energy sector client in identifying cyber security weaknesses associated with their Information Technology infrastructure that could be exploited. We also assessed potential gaps in their cyber security posture.

Risk Modelling

Predictive models and simulations to better forecast the impact of various issues on project delivery and operations with risk evaluated from multiple data sources.

Deloitte Case Study:

Deloitte US houses a Centre for Risk Modelling and Simulation to evaluate how a system might behave under normal conditions but also under hypothetical "what if" scenarios to better estimate the level of risk tolerance.

Predictive Project Analytics

In-depth analysis of project complexity and the optimum level of controls required to deliver it Referencing a large dataset from previous projects. This helps organisations to better manage project delivery risk, minimising financial, productivity, and reputation-based losses.

Deloitte Case Study:

Deloitte demonstrated for a client that the use of PPA at the inception of their project would have led to the immediate identification of the approach which was eventually deployed. The opportunity cost was assessed by the client at 5 saved months of programme time equating to an opportunity for multimillion dollar cost avoidance.

Risk-based Maintenance

Real time and predictive-based maintenance activities, potentially reducing duplication.

Deloitte Case Study:

Deloitte assisted a railway infrastructure organisation in the UK to optimise their capital investment in network infrastructure by assisting in implementing several predictive asset maintenance tools.

Real time data

Leveraging real-time data to provide risk-based operational decision making capability.

Deloitte Case Study:

Deloitte was engaged to help our client implement new program controls and an analytics and reporting platform to improve project and financial management as well as reduce risk and enhance safety for one of Europe's largest construction project.

POTENTIAL BUSINESS VALUE:

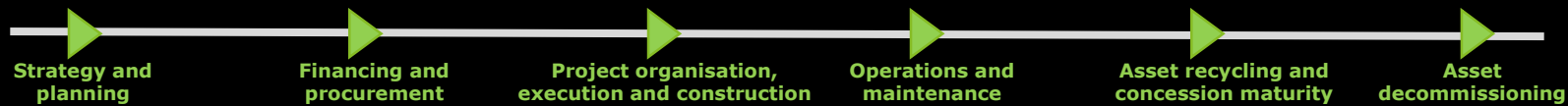
- Lower risk and cost contingency
- Capex and Opex savings through risk based maintenance vs reactive maintenance
- Analytics provides insights into more efficient areas of expenditure i.e. risk of spending in wrong area is lower

CAPABILITIES REQUIRED

- ✓ Cyber security Strategy
- ✓ Big Data Analytics & Modelling Capability
- ✓ Risk-Based Project Control
- ✓ Data Quality & Governance

ENVIRONMENT & QUALITY

Using technology to enhance quality and manage the project's environmental impact.



3D / 4D / 5D CAD and Geographical Information Systems (GIS)

Reduction in re-work and waste through more effective modelling in advance of physical construction. 3D CAD provides a single state visualisation, 4D adds a time element allowing construction sequencing and 5D adds a cost element to analyse spend over time.

Applied example¹¹:

Bam and Arup used 4D CAD in their sustainable approach to the design of the Leeds Arena, allowing them to 'build it twice' – sequencing construction once in 4D before constructing in reality on site. This led to efficiencies by identifying clashes before construction began.

Internet of Things (IoT) Sensors

Sensor technology designed and used in plant and equipment to optimise plant operations and reduce waste or carbon emissions. Data capture systems can also be embedded within infrastructure to provide real-time asset information virtually.

Applied example¹²:

In the water industry, US-based startup Fathom uses smart readers to let utilities detect leaks based on discrepancies in billing statements and then layers intelligence from deployed sensors to localise broken pipes.

Remote Vehicles (e.g. drones)

Remote vehicles can be deployed for site inspection, reducing CO₂ footprint and obtaining high quality data. Drones can be an efficient way to monitor construction progress, manage resources and reduce down time

Deloitte Case Study:

Deloitte has been working with a construction and mining equipment manufacturer to develop the use of drone mapping, in-vehicle monitoring and road surface analytics to identify opportunities for fuel reduction in quarry operations.

Asset Information Modelling

Provides increased understanding of an asset throughout its life. This gives potential to reduce waste through efficient maintenance routines and increases the likelihood of recycling asset components.

Deloitte Case Study:

Deloitte, together with IBM has developed an Intelligent Asset Control Centre (iACC). This is an interactive collaboration environment that uses a data and analytics driven approach enabling asset intensive companies to: Reduce lifecycle costs, improve asset performance and avoid surprises. Asset life can be increased by accurate monitoring and modelling rather than automatic replacement at end of design life thus reducing wastage.

POTENTIAL BUSINESS VALUE:

- Increased fuel efficiency and reduction in CO₂ emissions by using drones
- Cost savings by using IoT sensor technology for optimising plant operations
- Reduction in waste and re-work through CAD modelling in advance of construction

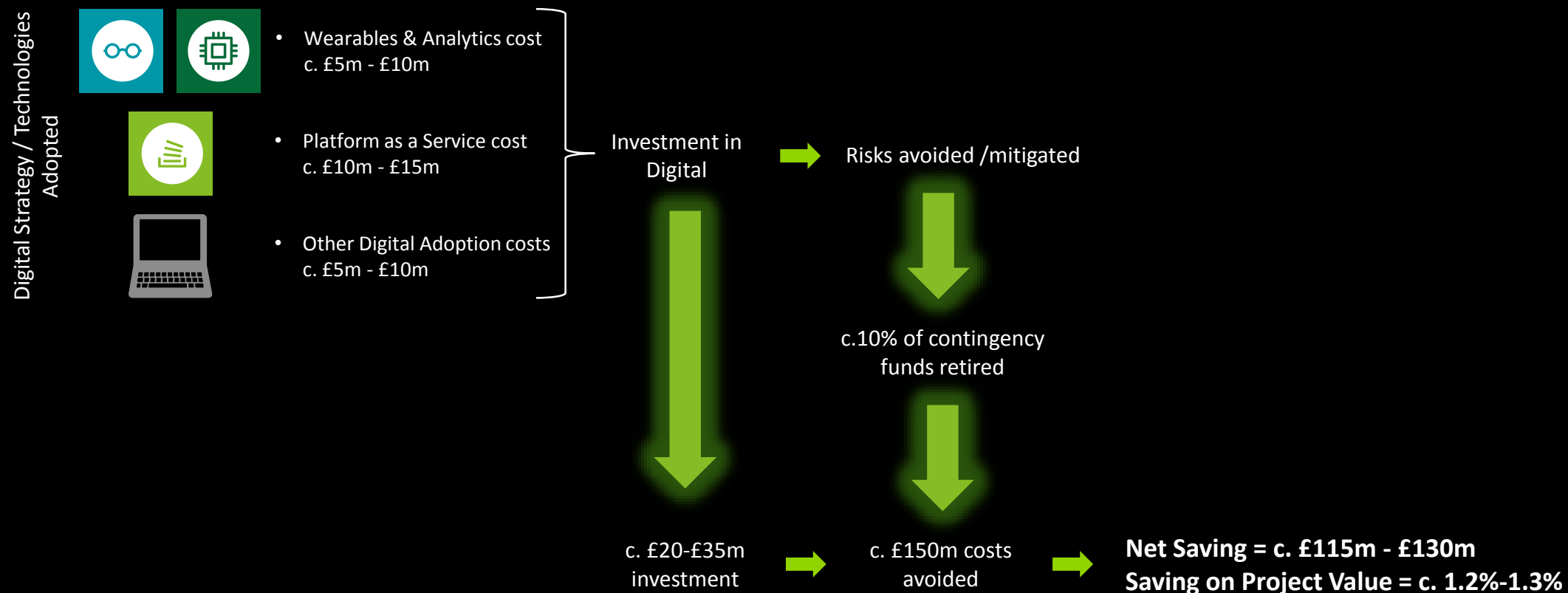
CAPABILITIES REQUIRED

- ✓ Asset Analytics capability
- ✓ Defined Processes & Standards
- ✓ Asset Data Quality & Governance

ILLUSTRATIVE CASE STUDY

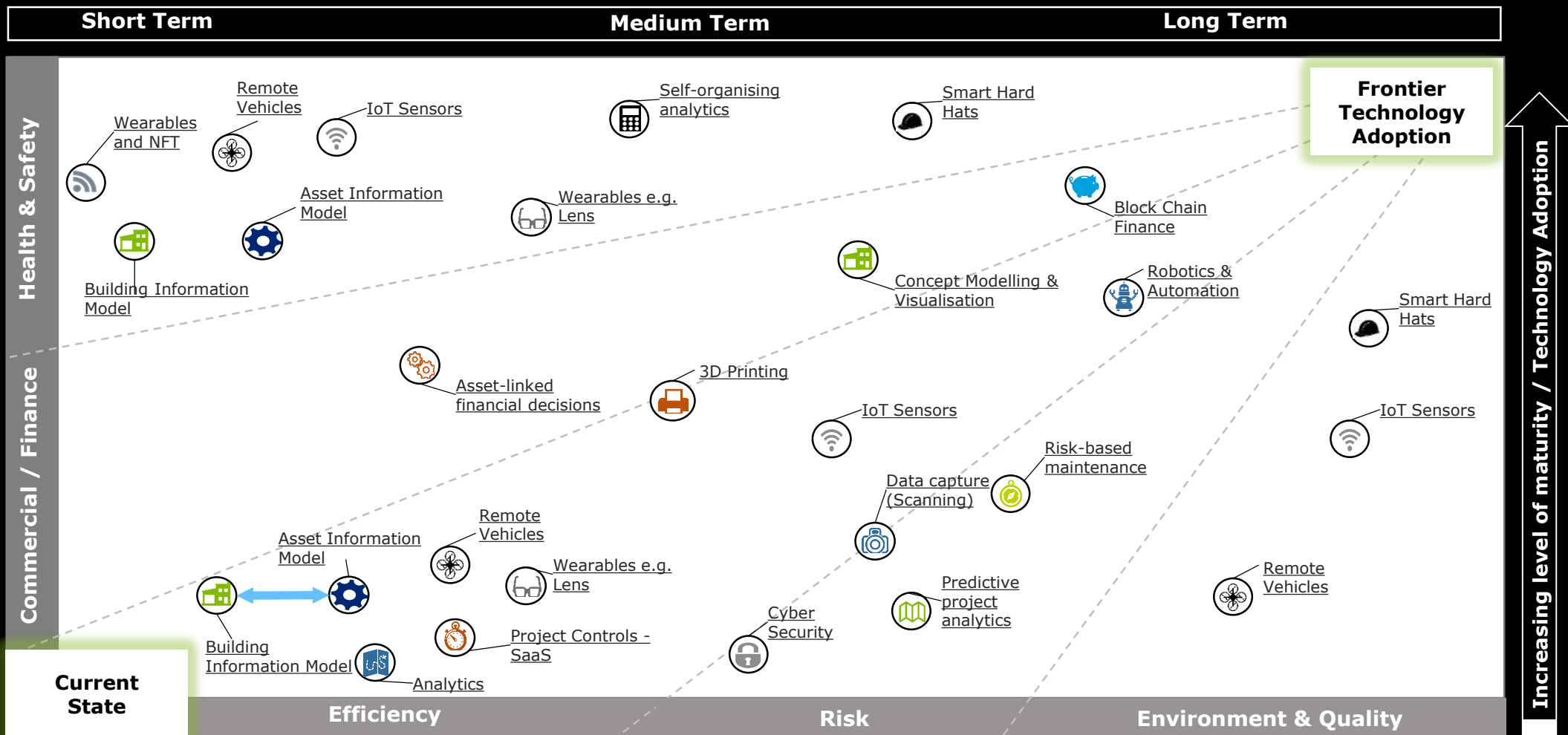
By utilising the previously referenced technologies early in the Capital Project lifecycle, we have seen clients realise benefits on their projects. Consider the following illustrative example:

Major Capital Project Value = c. £10bn
 Risk Contingency (15%) = c. £1.5bn



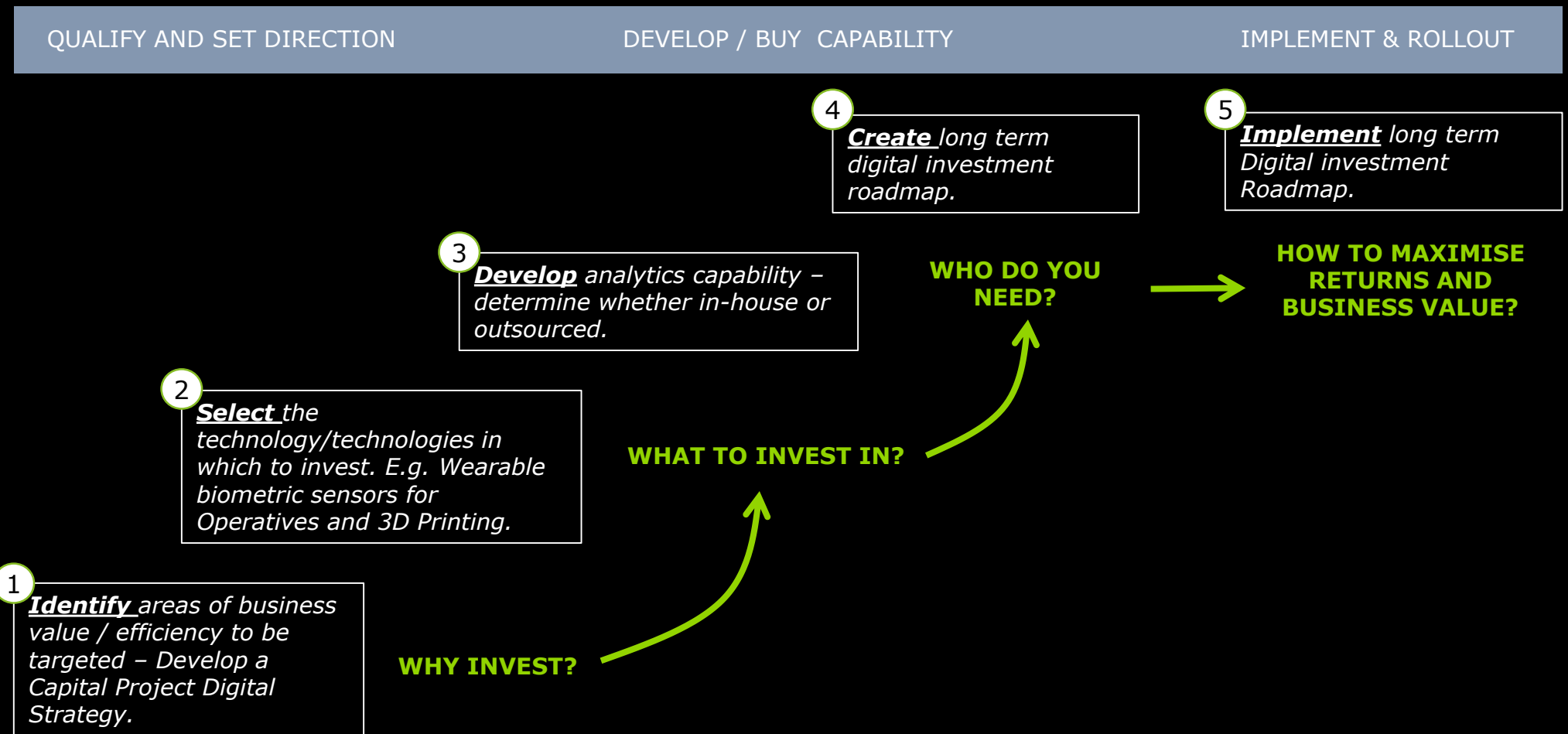
TECHNOLOGY BLUEPRINT

The technologies talked about in this document are at varying levels of development with some ready to adopt today. Others should be considered in longer term strategies ready for timely introduction in the future.



SETTING YOUR ROADMAP

To better take advantage of the new wave of technology a step change in digital capability is required. We believe that by taking the following steps organisations will be well placed to realise benefits on their Capital Projects by adopting the latest technology.



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