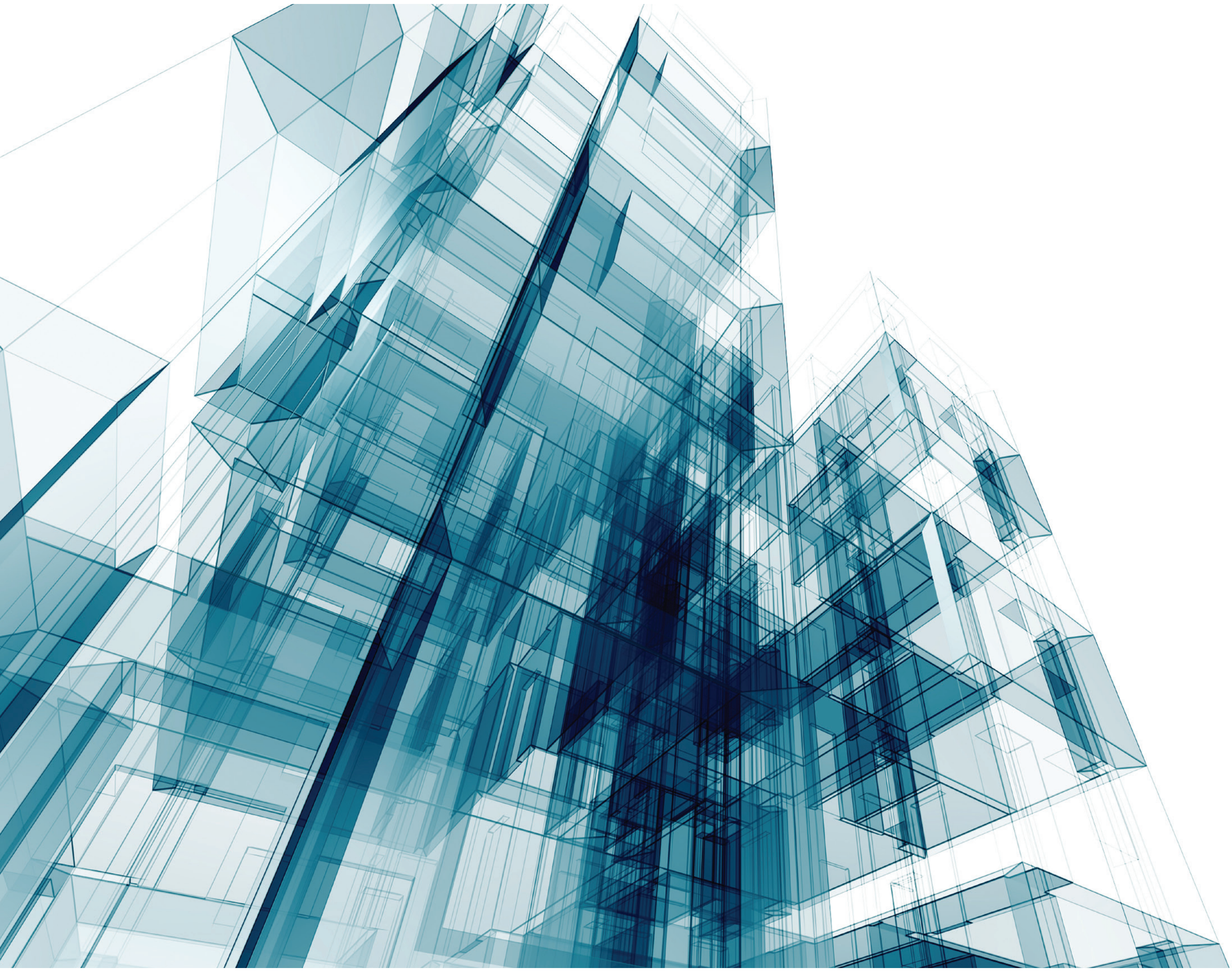
RICS guidance note

RICS professional guidance, UK

Digital systems and technology in infrastructure

1st edition, February 2018



rics.org/guidance

Digital systems and technology in infrastructure

RICS guidance note, UK

1st edition, February 2018

Published by the Royal Institution of Chartered Surveyors (RICS)
Parliament Square
London
SW1P 3AD

www.rics.org

Produced by the RICS Infrastructure Professional Group.

ISBN 978 1 78321 221 7

Acknowledgments

RICS would like to thank the following for their contributions to this guidance note:

Principal Author

Dr Robert Mallett (RICS)

Lead Technical Consultant

Alan Kirk FRICS (Transport for London)

Working Group

Stephen Blakey FRICS (Network Rail Ltd)

Richard Graham FRICS (Oval Konsult)

Martin Rowark FRICS (Watling Fosse Ltd)

Peter Sell FRICS (Gardiner & Theobald LLP)

RICS Professional Group lead

Steven Thompson FRICS (RICS)

RICS Publishing

Head of Publishing and Content: Sarah Crouch

Standards Publishing Manager: Antonella Adamus

Standards Publishing Project Manager: Katherine Andrews

Editor: Jill Haldon

RICS would also like to give special thanks to:

Mike Brown, Commissioner of TfL for contributing the Foreword

Shashi Verma, Chief Technology Officer and Director of Customer Experience at TfL for contributing the Executive summary

Caleb Butler (EY)

Sarah Drinkwater (K&L Gates)

Chris Hall (Cabinet Office)

Contents

RICS professional guidance

RICS guidance notes

Definition and scope

RICS guidance notes set out good practice for RICS members and for firms that are regulated by RICS. An RICS guidance note is a professional or personal standard for the purposes of RICS Rules of Conduct.

Guidance notes constitute areas of professional, behavioural competence and/or good practice. RICS recognises that there may be exceptional circumstances in which it is appropriate for a member to depart from these provisions – in such situations RICS may require the member to justify their decisions and actions.

Application of these provisions in legal or disciplinary proceedings

In regulatory or disciplinary proceedings, RICS will take account of relevant guidance notes in deciding whether a member acted professionally, appropriately and with reasonable competence. It is also likely that during any legal proceedings a judge, adjudicator or equivalent will take RICS guidance notes into account.

RICS recognises that there may be legislative requirements or regional, national or international standards that take precedence over an RICS guidance note.

Type of document	Definition
RICS Rules of Conduct for Members and RICS Rules of Conduct for Firms	These Rules set out the standards of professional conduct and practice expected of members and firms registered for regulation by RICS.
International standard	High-level standard developed in collaboration with other relevant bodies.
RICS professional statement (PS)	Mandatory requirements for RICS members and regulated firms.
RICS guidance note (GN)	A document that provides users with recommendations for professional advice and areas of good practice.
RICS code of practice (CoP)	A document developed in collaboration with other professional bodies and stakeholders that will have the status of a professional statement or guidance note.

Foreword

At Transport for London our purpose is to keep London moving, working and growing and to make life in our city better. London never stands still. It is growing at an unprecedented rate, with record numbers of customers and users relying on our public transport and road networks. Transport is core to making our city's growth productive; delivering the new jobs, housing and access required by those we serve.

At the same time, technology is changing the way in which we live, travel and work and we have been at the forefront of utilising digital systems and technology to increase capacity, improve reliability, safety and enhance the experience of our customers.

The pace of change in technology offers big opportunities, and we are keen to exploit these for the benefit of our customers. Examples include the remarkable success of payments made using contactless bank cards – accounting for around one-third of all 'pay as you go' journeys – and our approaches to open data, and the use of big data, to improve information provision and service planning. We intend to make even more data available to app developers and other partners, particularly to help relieve congestion on the road network and develop more tools giving predictive information to help people plan journeys.

Digital systems and technology are forming an ever-increasing element of the steady and sustained investment which is modernising transport and other national infrastructure, and are at the core of benefits realisation. Effective commercial management of that substantial investment has always been at the core of delivering value, but digital systems and technology introduce new challenges and risks which must be understood and managed.

We are absolutely committed to delivering value for money to the public, and these innovations in digital systems and particularly our effective commercial management of them, has played and continues to play a vital role in delivering on that commitment. Our investment in the Oyster card and contactless payment systems, digital signalling on the Tube, iBus automatic vehicle location and passenger information systems to name but a few, have given us a deep insight into the benefits, design, delivery and operation of integrated systems. This guidance note is one of the ways in which we wish to share that experience.

Mike Brown MVO
Commissioner, Transport for London

1 Executive summary

Technology and digital systems are increasingly important in all aspects of our lives. Their growing use reflects the value that judicious investment in these systems can bring in enhancing the efficiency of infrastructure. Numerous examples can be found where investment in technology has delivered disproportionately large benefits. Modern train control systems on London Underground are delivering a capacity increase larger than Crossrail, at a fraction of the cost. Transport for London's fare collection systems deliver efficiency improvements such that the investment can be paid off in months.

Yet, along with the growing use of these technologies, there are also many examples of poorly delivered technology that costs more than expected, is late, does not deliver the benefits, remains difficult to maintain and ends up with users locked into it for longer than they would like. Supplier markets are less mature and more fluid than would be seen in traditional infrastructure. For many high-end systems, there are no products available and the systems are created on a bespoke basis. The underlying systems themselves evolve fast. In long lasting projects such as Crossrail, many technologies become not just available but expected by the time the project is completed, having not been available or even contemplated at the start of the project

Many commercial issues that arise in technology and digital delivery are similar to that seen in more traditional infrastructure. But, equally, there are many differences that show the peculiar nature of technology and digital investment. This guidance note is meant to provide a starter for commercial managers.

The guidance is structured around the lifecycle of technology and digital investment. It uses two case studies from Network Rail and TfL to illustrate the note's key themes. Section 3 provides definitions and opportunities around technology and digital systems. Section 4 starts to define the role of the commercial manager in the delivery of technology and digital systems.

Section 5 outlines the key areas of commercial risk in digital systems and technology. Again, these are similar to the issues faced in core infrastructure, but the reader is invited to study the differences carefully. Solution selection, the first step, is a far more complicated exercise when the delivery of digital systems and technology takes place in an evolving marketplace. Cost estimation is challenging, mainly due to the absence of comparable historical data, when the exercise involves large and unusual systems, which is quite often the case with these projects.

In life management and end-of-life issues from the expiry, either of the systems or the commercial structures that support them, provide challenges that are not normally seen in core infrastructure. The role of intellectual property rights and its proper management can often determine success or failure.

Systems integration is a complicated area where skills are scarce and the challenges formidable. Determining the role of client versus contractor, and having clearly defined accountabilities in this area are essential. Alongside this, the role of testing, commissioning and defects management are discussed. Progressive assurance, the process by which confidence is gained by looking at the build stage of the digital system or technology from start to finish, has a key role. Unlike infrastructure, it is common in technology to create test environments that closely replicate the live environment, and allow extensive testing before deployment. Shortening the time cycles between build, test and deployment can help in defect identification and rectification.

The guidance note ends by considering the challenges in whole life costing in an area where underlying factors such as the base technology, supply chain and security are all evolving. Many of these challenges stem from technology life cycles being shorter, often a fraction of the lifecycle of major infrastructure. Unlike in the past, where major infrastructure was supported by electrical or electromechanical technology, modern software based systems allow opportunities for continuous upkeep so that obsolescence is never an issue. This requires a change in the approach to the delivery and management of major infrastructure.

Shashi Verma
Chief Technology Officer & Director of Customer Experience, TfL

2 Defining digital systems and technology in infrastructure

Digital systems and information technology (IT) play a crucial role in the functioning of contemporary society. Modern IT systems can store, retrieve, study, manipulate and transmit data for a vast and complex variety of purposes and – to establish the context for this guidance note – will clearly play a major part in the effective functioning of future global infrastructure programmes.

While both digital systems and IT technology share several mutual attributes and challenges (for instance such technology dates very quickly), for the infrastructure sector they are intrinsically linked to the assets themselves, and directly impact the delivery of value from those assets. For example, the implementation of digital signalling systems across the UK rail environment has enabled greater capacity to be delivered through existing infrastructure.[1] This intrinsic link drives aspects of the development and delivery of these systems, which give them a differing risk profile from either infrastructure assets or enterprise IT systems.

Modern transportation networks, such as Crossrail and the London Underground, require heavy, long term investment in new technology and digital systems. Thus, the design, procurement, delivery and whole life asset management of such systems form an integral part of the successful commercial management of the project.

This guidance note, the second in a series covering the *Role of the commercial manager in infrastructure*, sets out some of the key ways in which new digital systems and technology are procured across all economic infrastructure sectors. It highlights the associated risks and issues, and how commercial stewardship should be undertaken in the technology space. It does not look at the use of IT systems as part of the business enterprise. Rather, it sets out how digital systems are commercially managed from the procurement and implementation phases through to their operational, maintenance and whole life cycle management within infrastructure assets.

For the purposes of this guidance, RICS define digital systems and technology in infrastructure as a combination of the historically separate areas of:

- information technology (IT); and
- operational technology (OT).

Notably, each of these is intrinsically linked or embedded in infrastructure programmes.

On major infrastructure projects IT and OT are increasingly converging. Each brings its own distinct needs, risks and opportunities, while also having similarities; for example, both are underpinned by cyber security concerns. While making these distinctions clear, this guidance also seeks to identify points of commonality and clearly establish what is meant by systems technology.

By making use of case study evidence from Network Rail's Digital Railway, and TfL's successful implementation of Oyster Card and 'contactless' electronic ticketing technology across the London transport network, it will demonstrate the extent to which technology of this type is increasingly fundamental to infrastructure operational value.

3 The digital systems and technology market

Digital systems have significant potential to improve the design, delivery, management and daily use of infrastructure programmes. Lower IT costs, readily available and faster broadband connectivity, combined with ever improving computer capability all point to a future where infrastructure assets will be interconnected. In real terms, what this means is that new technological innovations will help create a world where both the existing condition and performance of built environment assets can be constantly assessed, and consequently better managed.

This technological potential is already being realised on the UK's rapidly developing digital highway, with digital sensors installed on key road networks monitoring the density of traffic and driver speeds, to facilitate better control of lane use and even in the re-routing of vehicles to avoid congested areas of the network. The resulting improvement in the UK's congested road network will eventually result in millions of pounds of savings in lost working hours, much improved road safety and a far less stressful journey for road users.

Digital sensors can be used across infrastructure assets to continually assess their ongoing condition and performance, proving an invaluable tool in whole life asset management. Performance monitoring sensors can detect variable conditions such as flow rates, pressures, temperature and loads, and can therefore be used accurately to assess operational efficiency and improve the quality of the service being delivered to the end user. In short, operational and conditional data drawn from digital sensors will enable better decision making regarding asset use, while also facilitating more cost-effective asset management.

Naturally, the benefits of digital technology extend beyond the infrastructure industry. As the 2011 government commissioned Hargreaves Review of Intellectual Property noted, 'the interests of the UK's creative industries are of great national importance. Digital creative industries exports rank third, behind only advanced engineering and financial and professional services.'[2] Clearly this constitutes a key growing area of UK economic activity, and will have a major impact on infrastructure delivery in the years ahead.

Indeed, the rapid growth in technological development itself will have major implications for global economic infrastructure. The Internet of Things, for example, permits commercial vehicles to be fitted with the latest IT enabling vehicle dynamics monitoring, intelligent navigation and fleet management to name but a few possibilities. Commercial vehicle terminals can be securely connected to cloud based platforms running big data analytics, which can subsequently be used to create end to end user solutions enhancing the user experience, improving reliability and security and reducing operational costs.

Artificial Intelligence (AI) applications, which are used to simulate human intelligence for problem solving or decision making across areas as diverse as engineering, economics, linguistics, manufacturing, law and medicine, are also proving successful when applied to transport infrastructure. For example, AI technology has been used to convert traffic sensors into intelligent agents, which are subsequently able to report traffic accidents and road conditions.

In the rail sector, Automatic Train Operation (ATO) provides different levels of automation. This ranges from technology that permits the driver to retain control of most functions, to semi-automatic train operation (GoA2) where setting the train in motion and stopping it is automatic, leaving the driver in control of the door activation system. The driver can override GoA2 if the system fails. GoA3 and GoA4 add more automation to the train operation process to the point where there is no requirement for a driver at all, as is the case with London's Docklands Light Railway.

Another major technological innovation is autonomous vehicle technology. Autonomous or driverless vehicles can sense their environment, and can be operated without any human involvement. Such vehicles rely on a variety of technology to identify their surroundings including radar, laser light, GPS and computer vision and, when finally introduced, will rely on infrastructure sensors, for instance at traffic lights, when operational.

In short, the digital technology underpinning transport infrastructure is evolving rapidly, and will have a profound impact on human society. Its research and development, implementation and whole life management will generate vast possibilities for the infrastructure commercial manager.

Case Study 1 – Investment in digital technology for rail

The Digital Railway Programme

The following case study provides evidence of the increasing levels of investment in digital technology across UK infrastructure assets, together with the benefits of this investment. The strategy adopted by the Digital Railway programme has the objective of modernising signalling and train control through digital system upgrades. It demonstrates the growing and central importance of digital technology as a core component of infrastructure programmes, and a current example of how the commercial management processes detailed in this note will be increasingly in demand on major infrastructure projects.

Passenger numbers in the United Kingdom have doubled since 1996, and are set to double again over the next 25 years. Long term demographic trends, such as population growth and urbanisation, mean more people are travelling within and between major UK cities and city regions, but major stations across the network are already full at peak times. Similarly, the Department for Transport's (DfT) rail freight study also shows growing demand for rail freight services in recent years.

Network Rail's Digital Railway Programme aims to bring together all aspects of the supply chain, to revolutionise the way the rail industry approaches 'change' to deliver improvements for the industry, and benefits for passengers and freight.

Digital Rail objectives

The focus for the programme is to investigate the most cost and time effective methods to increase capacity on the existing rail network. By doing so, there will be wider benefits for business and society including those shown below:

For passengers	For freight	For the UK taxpayer & economy
Improved safety	Increased capacity	Stimuli for housing & economic growth across UK
More trains	Greater availability	Greater value for money from investment in rail
Better connections	Optimised efficiency	Greater workforce mobility
Greater reliability	Stable environment for growth	Creation of new, high skilled engineering jobs
Reduced crowding	Real time information	Regional & national growth through increased opportunities to export
Real time information	-	Creating a world leading rail industry

The successful implementation of digital technologies is reliant on the infrastructure sector's readiness to accept, understand and embed their usage and maximise the benefits of the overall systems. The technology exists and continues to develop through a number of mature European and domestic initiatives, examples of which are:

The European Train Control System –allows trains to run closer together and to travel at their best speeds while maintaining safe braking distances.

Connected Driver Advisory Systems (CDAS) and Automatic Train Operation (ATO) – provides precision support to drivers in the cab so that they have the information they need at the right time to boost performance and safety.

Traffic Management (TM) – maximises performance as trains flow across the network, maximising the throughput that existing track can support and adapting in real-time as network conditions change to aid rapid recovery.

Telecommunications and Data – will underpin and connect all these systems through a Fixed Telephone Network (FTN) and a Global System for Mobile – Railway (GSM-R).

To determine the best use of funding for targeted deployment, the Digital Railway programme has developed five strategic business cases as illustrated below.

Benefits – Targeted priority deployments

If all targeted schemes are delivered as planned, the Digital Railway will operate on routes covering 70% of all UK passenger journeys.

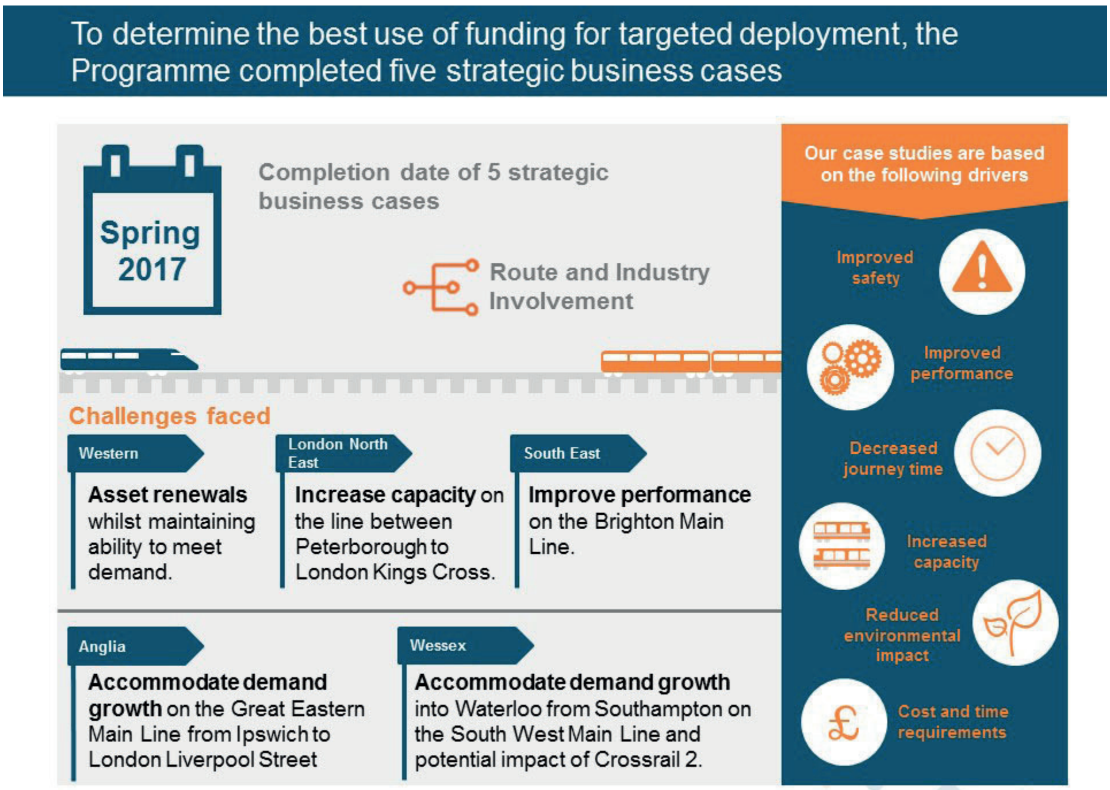
Examples of the anticipated improvements to services resulting from the successful introduction of digital technology include:

- **Capacity and Frequency**: increases across several routes include 15% on the Great Eastern Main Line, the South West Main Line and 25% on the Moorgate branch line.
- **Value for Money**: across the various routes, delivery via Digital Rail is expected to be 40% to 50% cheaper than the 'conventional' equivalent, with associated reductions in signalling renewal costs.
- **Performance**: is expected to improve with reductions in reactionary delays and journey time improvements.
- **Safety**: will be improved by a significant reduction in the potential for signals to be passed at danger.

Open questions

Within the rail infrastructure sector dialogue is ongoing as regards what engagement with the supply chain will look like, the level of collaboration that will be required, the forms of contract (NEC3, NEC4, other?) and, of course, the commercial stewardship of this multi-billion pound programme. Much of the latter relates directly to digital spend rather than physical construction. Questions around the capacity and capability of the supply chain, cost planning and commercial taxonomy, approaches to value for money, valuations, change control and claims for the digital investment will all need to be answered.

(Source: Network Rail)



4 What is the commercial management of digital systems and technology?

The key tasks and responsibilities underpinning the commercial management of infrastructure were set out in the first RICS guidance note in this series, *The role of the commercial manager in infrastructure*. This current guidance note should be read in conjunction with the preceding note, and digital systems and technology viewed as an additional set of commercial risks and challenges.

What should be established here is that the delivery of digital systems presents different challenges to commercial managers, given the wide range of technology that is available and the prevailing market conditions in this sector. Providing effective commercial stewardship where digital systems and technology are involved, requires the application of existing skills and processes with a different emphasis combined with new knowledge, to reflect the differing commercial risk profile. The specific aspects of digital systems and technology affect the ability to anticipate, influence and demonstrate what those aspects of programmes and projects should cost, will cost, did cost and why.

There are several reasons for this unpredictability. Digital systems are characterised by a unique malleability, which means that each possesses different development cycles involving uniquely different methodologies. Systems inhabit an accelerating obsolescence curve, and this renders their commercial management complex and difficult. Additionally, there is frequent market disruption (often in the form of new technologies), along with a serious lack of suitably qualified expertise capable of addressing the commercial dimensions of technology contracts effectively. The impact of change, the consequences for the management of change control, and the ability to measure performance and demonstrate value, are different across the systems and physical environments.

In addition, while the digital and technology markets have adopted much of the language that would be familiar to a construction project manager to signpost product design, development and deployment, almost none of the language, definitions and process familiar to a construction commercial manager are in evidence.

Commercial managers should recognise and address the above issues if they are to be effective in the provision of the required commercial stewardship. Certainly, it is useful to look at how the commercial management of the physical environment has evolved, to provide context to the emerging challenges and risks associated with bringing commercial stewardship to the digital environment.

Throughout much of the 1960s and 1970s, little emphasis was placed on the commercial management of both mechanical and electrical, together with heating and ventilation installations in buildings. The advent of computers in the work place, and increased expectations for environmental controls to the office and public built environment, not only drove the development of raised floors and suspended ceilings, but the emergence of a new and significant specialism; the mechanical and engineering sector. In addition to a specialist market of subcontractors, with bespoke forms of contract, came the mechanical and engineering (M and E) surveyor, with a keen understanding of the technology, terminology, IPR, buildability and commercial dynamics of M and E installation and the associated market. These individuals became the commercial stewards of a sector that is now fully integrated into stakeholder and practitioner thinking when procuring and, ultimately, delivering in a physical environment.

The obvious question that emerges from the above assessment of recently developed commercial management disciplines, is where is the growing commercial expertise in the modern equivalent of the 1980s M and E sector, the digital environment? More importantly perhaps, what must be done and by whom to drive a maturing capability across the infrastructure sector for effective, commercial stewardship of an increasingly important element of successful infrastructure delivery?

This guidance is the RICS' first response to such questions, and it seeks to identify the key areas of difference to assist with the identification of commercial risk and the need to modify, expand or create appropriate commercial management processes and procedures for the digital environment. Awareness of these differences, combined with the knowledge, skills and experience needed effectively to manage them, are the core features of digital commercial management. Therefore, this guidance encourages a blending of good and effective infrastructure commercial management, with best practice in the technology environment.

5 Key areas of commercial risk in digital systems and technology

The large sums of capital and the significant deployment of resources demanded by large infrastructure programmes mean that client organisations look to identify, evaluate and manage any factors that might jeopardise the ultimate delivery of the project objectives. The commercial manager's role, in terms of the management of this risk, is to manage a 'process of risk transfer and drive a level of competitive tension that ensures value for money.'[3]

HM Treasury's *Orange Book*, the government's guidance document covering risk management, emphasises the importance of the relationship between effective risk management and successful value for money project outcomes:

'In recent years, all sectors of the economy have focused on management of risk as the key to making organisations successful in delivering their objectives whilst protecting the interests of their stakeholders. Risk is uncertainty of outcome, and good risk management allows an organisation to:

- *have increased confidence in achieving its desired outcomes;*
- *effectively constrain threats to acceptable levels; and*
- *take informed decisions about exploiting opportunities.*

'Good risk management also allows stakeholders to have increased confidence in the organisation's corporate governance and ability to deliver.'[4]

However, the commercial management of digital systems and technology presents a different level of risk profile, and indeed different types of risk, from the normal delivery of infrastructure fixed assets. The following sections set out the different approaches required to manage the various key elements of digital infrastructure delivery, from product selection procedures through to whole life costing and cyber security.

5.1 Solution selection

The first guidance note in this series highlighted the importance of project commercial managers engaging with clients at project initiation phase, to provide strategic advice and business case benchmarking guidance. This early client engagement process permits careful consideration of value driven outcomes prior to any market consultation, and as the guidance recommended:

'The commercial manager should play a major role in project optioneering, in other words helping clients to identify which option is economically best for them and will constitute the optimum solution. Commercial managers are ideally placed to deliver un-biased, objective analysis of different options to enable clients to identify the right project to develop.'[5]

In terms of digital systems and technology, commercial involvement and decision making begins before potential product solutions are assessed as to their suitability for a specific infrastructure project. Commercial managers should advise the client so that they are clear about what they require the technological solution to achieve in terms of their project business objectives, and discuss the commercial viability of each potential solution realistically. Commercial managers should also encourage the client to provide a clear indication of how the digital element of the project should be expressed, and subsequently what form of packaging strategy should be adopted in each phase. It is important that clients are clear about which build and/or buy decisions they will need to make, and when these decisions will need to be made.

Product selection, or determining which system or technology solution will best deliver both the client's requirements and provide value to the project, is a crucial element of the business case on major projects. It is a key factor in determining the relationship with the supply chain, and hence the commercial risk profile of the solution. Commercial managers should be able to provide excellent advice on the commercial implications of product selection. They should also be capable of effective management of the engagement with the market, to enable a proper understanding of what is already available to the project in terms of existing solutions, their characteristics and constraints. They should be able to advise the client on what the different commercial risks associated with using available products are to meet the project's overall requirements, and those associated with the use of a more bespoke solution if this is a better fit for the project.

Clearly significant issues will arise from selecting either a pre-existing solution or a bespoke one. Off the shelf solutions will already have their own background IP, and will present a different commercial dynamic to solutions that are new and built from scratch. Any solution that is customised or entirely new will not have been delivered in this form previously, and commercial managers should remain aware that this will generate greater costs and greater levels of delivery uncertainty.

At the same time, commercial managers should understand that even packaged solutions will invariably require a high-level of customisation, or an entirely new software code to be written for them, as is the case with any large-scale infrastructure project implementation. In addition, practitioners should be aware of the organisation that they are contracting with. If, for instance, the project is acquiring an 'off the shelf' product requiring design development, it would be unwise to contract with the construction entity or the body responsible for developing the software in question. Contracting with such parties could result in a significant cost mark up.

While bespoke solutions can deliver the client requirements precisely, they can greatly increase the level of risk and affect both the relationship with the supply chain, and the ability to construct the project. Readily available products may make it easier to deliver the system into the implementation phase, but could also involve more changes to the client's business operations. Therefore, good commercial stewardship involves deciding how much of the client's finances should be deployed to make the system fully operational. On major infrastructure projects cost uncertainty interfaces with business processes, and good commercial management entails changing these processes to deliver a fully operational asset.

Given the potential longevity of the solution requirements, the long-term stability of the supplier(s), product development and support risks need to be properly assessed and managed accordingly, by way of an effective strategy.

Considerations in the solution selection area have broadened with the emergence of various internet enabled, cloud computing delivery models, including Software as a Service and Infrastructure as a Service. Where software development is required, the approach to the procurement and the commercial risks associated with such development also require consideration, with traditional and agile methodologies having differing advantages and commercial risk profiles.

All these options need to be considered alongside the client's technology strategies and roadmaps, including their use of DevOps and Information Technology Infrastructure Library (ITIL) considerations where relevant.

To provide effective guidance, commercial managers advising on digital systems and technology will need to be well informed as regards the digital market, as well as its technology and terminology across several facets.

5.2 Cost estimating

Project cost estimating is a key function of the commercial manager, although there are crucial differences between the way this is carried out on traditional construction projects and on infrastructure programmes, particularly those featuring significant systems and/or technology. For instance, when a client engages a construction quantity surveyor to estimate the cost of an office block, the latter can turn to a large range of skills and a substantial amount of readily available data to produce a cost estimate. Accordingly, the cost of the office block project can generally be estimated with confidence.

The specific characteristics, particularly the implementation constraints and methodologies, mean that this is often less straightforward for the delivery of infrastructure. This is especially the case with the cost estimating of digital systems that are to be part of infrastructure programmes. The cost estimation process for such systems is complex and niche, especially where the technology is new or novel. Therefore, commercial managers should aim to reduce uncertainty and promote proper and effective cost planning. Estimating for business case and optioneering is likely to require the creation of candidate solution architecture(s), and skeleton designs which can drive high estimate tolerances.

New technology invariably generates greater uncertainty around cost estimating, and commercial managers should consider what the cost drivers will be as well as what is likely to influence cost. They should be aware that the biggest risk comes with over-reliance on the supply chain, and that such over-reliance will be greatly favourable to the supplier. In practice, this means that unless the necessary steps are taken early in the project delivery process, the client may not have the level of technical expertise necessary within their organisation to challenge supplier advice, thereby leaving themselves exposed to significant financial risk.

Commercial managers should provide the relevant commercial advice to the client. They should ensure that the client's organisation has access to sufficient levels of technical expertise that will permit them to properly evaluate the risks, and to determine whether a technical solution is appropriate to deliver the business case. If the relationship with the supplier is likely to be a long-term one, then commercial managers should ensure that the client understands that unless they have sufficient levels of in-house technical capability to commercially manage the supply chain, they will be greatly increasing their risk and cost exposure. When reviewing whether any relationship with a supplier is likely to be long term, commercial managers should also consider ways of leveraging commercial advantages from this arrangement.

5.3 Commercial management of intellectual property rights

Intellectual property (IP) refers to creative products of the human mind whether it is art and literature, scientific concepts, symbols, names, images and so on. Intellectual property rights (IPR) can best be defined as the rights of those individuals owning the IP which are enforceable by law, and they fall into four principal categories:

- copyright
- trademarks
- design rights; and
- patents.

This guidance does not cover the legal aspects of IP and IPR, but sets out how IPR on major infrastructure projects should be commercially managed, to avoid significant and unnecessary expenditure. Commercial managers should aim to establish what a client needs in terms of digital systems and technology, and thereafter create a dialogue with the requisite supply chain. Put simply, it involves commercial managers thinking ahead and deciding what type of relationship they wish to have with IP suppliers. Will this be an ongoing relationship that extends beyond delivery of the project? If so, who within the supply chain owns what in IP terms?

Major infrastructure clients such as TfL procure IPR from third party organisations as part of their transactional relationship with them, while at the same time creating IP during their business dealings. If TfL, or any major client, do not secure the necessary IP rights from third party suppliers they will not be at liberty to use its IP, and may face significant costs in attempting to do so. Commercial managers should, therefore, ensure that IP is firmly embedded within the supply chain planning, and that the nature of the relationship with suppliers is clearly established and defined.

In terms of infrastructure digital systems and technology, it should be stressed that any approach may apply differently to the mechanical and electronic parts of any system, which will be gradually replaced over time than to the software, which may be gradually upgraded. Commercial managers should, from the outset of any major infrastructure project, consider the consequences of the client changing their mind, how easy replacement of all or parts of the system is likely to be and how important a transition process might prove to be in any replacement process. Commercial managers should be aware that supply chain dynamics, and even their composition, can change over the life of a system.

Contract considerations

'As mentioned throughout this paper, there are many issues which the commercial manager should consider when managing digital systems and technology. One of the main roles for a commercial manager is managing the contract, and therefore it is important to consider the following at the outset:

The commercial manager should carefully delineate areas of interface and ensure that these are allocated to those best able to manage the risk, or to share risk through appropriate mechanisms within the contract.

Commercial managers will need to consider the timing of agreeing technical support and maintenance contracts. There are commercial and practical advantages in agreeing the maintenance terms for these digital systems at the outset, so that they are not subject to re-negotiation by the contractor in their own favour once the works are under way.

As mentioned throughout this paper, commercial managers will need to focus particular attention on IPR issues. It will be necessary to ensure that the licences to use, adapt and develop the digital solution are sufficiently broad, including in terms of permitted purpose.

Commercial managers should give consideration to the critical stage between handover of the digital solution and the system achieving the performance guarantees, as completion mechanisms within a traditional engineering contract may need to be modified.

Furthermore, commercial managers should consider the type of contract they intend to use before contract award, as traditional engineering contracts do not sit well with the iterative nature of software development. Issues relating to scope definition and the traditional concept of 'defects' are not easily transferable, and therefore a bespoke contract could be more suited.'

Source: Sarah Drinkwater, K&L Gates

5.4 Approaches to the commercial management of IPR

The key to avoiding future costly disputes over IPR issues is to ensure that absolute clarity and transparency underpin all IPR provisions. TfL's Oyster Card electronic ticketing system (see Case Study 2) provides an excellent example of the development of the commercial management of IPR. Established under a Private Finance Initiative (PFI) in 1998, the IP for the Oyster system was owned by TfL's third-party partner and their supply chain. The PFI contract IPR provisions contained many weaknesses around the comprehensiveness, and completeness, of the IPR escrow deposits (see below), and the timing of their release along with the rights to the Oyster brand. TfL used their right to terminate the PFI early to negotiate a new interim contracting arrangement. This subsequently enabled TfL, among many other enhancements, to control the modularisation, expansion and verification of the IP deposits, enabling their use by any third party. It also permitted the transfer of ownership of the Oyster brand, and provided TfL with ownership rights to new foreground IP. These enhancements enabled a successful competitive tender process for the successor contract.

This example clearly demonstrates the importance of ensuring that intellectual property rights can be exercised once they have been secured in a contract. Commercial managers should ensure, by seeking specialist advice if required, that they actively manage all those provisions within a contract which relate to these rights, along with all the supporting policies and procedures.

Commercial managers should consider the following in determining their approach to the commercial management of IPR:

- **The IPR landscape** – Is the digital solution under consideration the product of thorough and effective market engagement, and is it 'off the shelf' requiring configuration? As this is rarely the case on major projects, commercial managers should seek specialist advice before deciding who will manage system disaggregation (for instance the software may be selected independently of the hardware), who will be responsible for system integration and ultimately the completed system. If the system is not 'off the shelf', will the intended solution need to be customised, or newly developed innovation? If so, does the client wish to cover the costs of the research and development?
- **Single supplier risk? –** It is vitally important to determine what type of relationship the client/ project should have with third party suppliers, particularly if there is only one supplier. Commercial managers should consider whether the solution requires maintenance and/or support, whether maintenance is affected by ownership of the IP and what might happen in the event of supplier insolvency, strategy change or end of life. Commercial managers should discuss with the client whether they wish to rely on a single supplier, with the caveat that it is wise to avoid this whenever possible. They should also discuss what alternatives, if any, are available in the market.
- **Commercialising IP?** – Does all or part of the solution have a potential market? Will any potential revenue be more than any costs incurred in the marketing and protecting of the IP? TfL's 'contactless' card payment system, for instance, took many years to develop and the concept of *how* to sell this service had to be given careful consideration. Commercial managers should be aware that protecting the IP is a cost.
- **Maintaining the IPR** – Will the IPR be transferable, and does the client organisation have the skills and resources required to maintain and validate the IPR? If the IPR is transferable will other suppliers be able to perform maintenance tasks, system upgrades or even create new versions of the solution? Can the required IPR be separated from the overall IPR for use by the client?

5.5 Selecting the IPR position

Commercial managers should ensure that the above assessment of client needs and potential exposure to risk is thoroughly undertaken, and well ahead of any decisions being taken on the IPR position that the project will require. There are two main types of IPR:

- background IP – the IP rights owned by each of the project participants (clients and third parties) prior to any commencement of research and development; and
- foreground IP – the IP generated by the parties within the framework of the project agreement.

The client's requirements should drive the decision on IPR selection, however commercial managers should ensure that the choice is compatible with the market and allows for free and open competition.

Commercial managers should recommend the best IPR solution to the client from the many positions that are available. These include:

- the client to own all the background and foreground IP in the solution
- the supplier to own all the background IP (issued under license to the client), leaving ownership of all the foreground IP to the client
- the client to own the core IP, leaving the remainder under the ownership of the supplier who then issues it under licence to the client organisation
- the supplier to own all background and foreground IP, which it issues under licence to the client; or
- the client and supplier to jointly own most or all the IP.

It is important to note that IP can be generated at any level of the supply chain, and that all layers require management. Commercial managers should not simply manage the top layer in the expectation that this layer, in turn, will manage all lower layers, and so should consider due diligence, audit and verification processes to properly manage this risk.

They should also make use of arrangements such as escrow, which allows for the IP to be held by a third party and released to the project client in the event of supplier business failure, contract default, etc. This will ensure that a discernible IP is readily available to the client, rather than the client becoming reliant on a supplier who may be reluctant to release it for whatever reason. Given that specialist providers normally carry out such a function the resulting non-standard terms could be difficult to negotiate, and therefore, the terms for release of the IP should be carefully established to avoid unnecessary delays.

If necessary, commercial managers should themselves seek specialist legal advice to be able to provide clients with informed advice on other common forms of licensing. Open source and public domain licences, for instance, allow software and other related products to be used, modified and shared by other users under specifically defined terms and conditions. These types of licence often permit third parties to modify the source code or software design for their own use, and such arrangements are normally available free of charge; however, this will be subject to strict compliance with the terms of the licence. Accordingly, such software and products require the same level of care in terms of licence management as any other form of IP. A failure to do so can result in significant commercial risk arising where a licence breach has occurred.

It is important to note that open source licences may only be free for non-commercial uses, require software code to be placed in the public domain or require potential users to include the names of the software authors, together with a copyright statement within the software code. Under such licensing terms ongoing auditing of the software code will be vitally important to be able to provide proof of licence compliance.

5.6 Systems integration and interface management

Systems integration can be defined as the process whereby the component systems and subsystems of an infrastructure asset are brought together, to function collectively as one operational system. This is a multi-layered task designed to ensure that a system can deliver its overarching functional purpose, and involves the successful linking together of often disparate systems.

Understanding the layers, the component systems, the sub-systems and how they interface and interact with one another in terms of design, development, delivery, hand over and operation is critical to effectively managing the commercial risks. Technical challenges and commercial ‘friction’ typically arise at the interfaces between the components and sub-systems, hence there is a need to ensure that contractual architecture and commercial structure effectively allocate and incentivise the management of these risks.

The London Underground is a good example of a major infrastructure asset whose systems span a multitude of component layers and types. For instance, an Underground line will include operational staff, rolling stock, signalling, power, communications, depot operations, maintenance and so on. These components all need to operate together in an integrated and efficient manner to deliver the service. Ultimate responsibility for integrating all these elements rests with London Underground as the operator. Responsibility for some component systems is outsourced, with those suppliers being responsible for the integration of the sub-systems within their component system.

Gaining an understanding of these component systems and sub-systems and how they interface with one another, whether physically or logically, is essential to capturing the associated risk, matching to market capability and so informing any packaging and contracting strategy. In a digital systems context, interface management is how the definition, control and communication of the information needed to allow non-related system areas such as services, equipment, software and data to operate together is carried out for the system to function correctly. New infrastructure systems frequently require external interfaces with other systems or services, and each of these interfaces themselves will need to be defined and controlled in a way that enables their efficient use. Interface management, therefore, takes place at the system design stage, and should continue throughout the operation and maintenance phases to establish:

- how the system will function; and
- how it will be kept functioning efficiently in the post-delivery phase.

Physical and operational interfaces also need to be considered. For example, environmental conditions, such as temperature or humidity and power quality, can have a significant impact on the performance of technology. End user interfaces are crucial to the successful efficient operation of any digital system.

Systems integration and interface management is not just a matter for delivery, but should be considered as a whole-life process that must effectively manage change without material service disruption. Commercial managers should understand every detail of the systems being created, and should be able to engage directly with technical experts with a view to translating this into a commercial model for the client.

TfL’s ticketing technology faces several system integration challenges. Not only does the ticketing system have many external interfaces to other digital systems, it also has a myriad of internal sub-system interfaces along with a mix of supplier developed and TfL developed software and interdependencies. Ensuring an effective end to end customer facing service, alongside the collection of billions of pounds of revenue annually, is essential to business performance. To ensure that systems integration delivers a functioning, efficient and safe infrastructure system, commercial managers should ensure that:

- the burdens of integration are focused at points in the system that can handle them
- risks are allocated appropriately
- the testing and commissioning procedures for each part of the system are robust
- a competent professional is appointed to carry out checks
- sub-contractors manage IP/IPR efficiently; and
- the system integration and interface management tasks are undertaken on a whole life of the asset basis.

Commercial managers should establish a relationship based on trust with project suppliers, while at the same time verifying all decisions made on the basis of providing sound commercial stewardship across all areas of interface management activity. They should be constantly aware that financial remuneration for any system failures may not be adequate compensation should system integration fail to deliver an efficient, functioning infrastructure asset, and ensure that this is made clear in the contract terms.

5.7 Testing, commissioning and defects management

Investment in new digital systems is capital intensive, with a significant amount of the sums involved being committed prior to the system entering the delivery/operational phases. If suppliers are involved in financing the overall costs of developing and installing the technology, this will invariably increase the costs still further. While these sums will have been invested very early in the programme, it is difficult at that stage to demonstrate the delivery of the full value the technology itself potentially offers the client and the end user.

Commercial managers should remain acutely aware that system interfaces must work effectively to the benefit of the end user. To ensure that this happens as effectively as possible at the delivery stage, major transport operators such as TfL test elements of any new system in a staged way during the development phase of the project, a process known as progressive assurance. Making extensive use of the process across the developmental stages of any project gradually increases overall confidence in the system, and will allow the organisation to be assured that:

- the new system works and system interfaces interact with each other correctly
- the system meets the full project requirements; and
- it delivers value for the client and the end user.

System testing is comparatively more rapid and straightforward across smaller system delivery projects, but much less so on larger, more complex systems such as TfL's Oyster Card and contactless ticketing systems. Given the scale of such programmes commercial managers should decide how and when to test, how a test can be determined as meaningful and how the testing process can itself be designed to demonstrate the gradually increasing value delivery. For example, this might entail increasingly integrated testing in a test environment followed by progressive deployment, but low impact testing in a production environment culminating in gradual migration in an operational environment. Commercial managers should be aware that effective testing increases confidence across the whole of the project, and should be designed to ensure that hardware and software components all work.

5.8 The testing process (progressive assurance)

The commissioning process involves moving from artificial testing to bringing the new programme into live operational service. This may entail a high risk 'big bang' implementation during which the old system is switched off and the new system is activated fully, or it may involve gradual migration. A detailed testing strategy should be developed using a risk based approach, which may lead to migration first being undertaken on a comparatively simple part of the system, while the main body of the service is running normally. Testing can also be undertaken by way of 'parallel running', whereby newly installed systems are run in parallel with existing systems until the new system is proven to be stable. Making use of the testing process will make diagnosing any problems that arise during testing much easier.

In introducing its new electronic ticketing systems across the London Underground, TfL made use of progressive assurance testing in the following sequence:

- system modelling
- testing in a test environment
- Oyster Card tested by a small group of people in the live environment
- staff were then introduced into the testing process using the simplest product
- these were followed by gradually increasing numbers of season ticket holders; and
- finally, the most complex system functionality *Pay As You Go* was introduced, initially without fare capping and eventually with that capability introduced.

Similarly, the 'contactless' payment system also underwent extensive piloting before being gradually introduced to the customer base.

Commercial managers should be aware that the systems and technology environment is very different to that of a standard construction project. Commercial managers working on digital systems in infrastructure will need to have a good understanding of software technology, and understand that the increasing complexity of digital systems creates the potential for bugs. They should consider whether any bugs that emerge during the testing process are important, and whether they could affect the functional delivery of the system and its stated requirements.

Commercial managers should recognise that bugs can develop into a system defect, and that such defects may be less tangible than those found in the construction environment. They should also ensure that while such imperfections may exist, it may not be necessary to spend money and time resolving them immediately, particularly if the defects do not affect the functioning of the system as a whole. System defects should, therefore, be managed carefully and may be resolved at a later stage, although it should be noted that this may be more expensive.

In short, commercial managers should consider regularly reviewing how best to protect their clients from any defect generated risk at the back end of all projects. As part of this assessment process they should aim to ensure that suppliers know what they are doing, and are doing it effectively. They should also define a system for testing that balances risk with the time/cost pressures of undertaking testing.

5.9 Transitioning

Transitioning and transition planning entails delineating the tasks and activities required to deliver an infrastructure project from the development or pilot phase into production, operations and maintenance. It is this process which determines whether the system will deliver the intended value. Commercial managers should seek specialist support prior to preparing a properly structured evaluation of the available options, and advising the client on how best to introduce a new digital system into the wider organisation. They should also clarify what needs to be done to ensure that the system is ready at the start of the operational phase. It is important that commercial managers advise clients on the contractual management of the operational readiness of any new system, to avoid incurring any additional costs that might result from the system not actually being ready.

5.10 Whole life costing

The commercial dynamics of modern project delivery mean that commercial managers are required to place great emphasis on the need for the whole life costing, and life cycle management of infrastructure assets. This requirement directly shapes the nature of the project's ongoing relationship with its supply chains, and from the outset commercial managers should be aware that purchasing a technology system may lock the client into a long-term relationship with one or more suppliers, with various potential implications for whole life costing:

- suppliers may cease supporting a specific type of system thereby making any required changes to it more difficult in future
- clients may desire systems to have a certain life span, which may not align with the suppliers' view of this life span
- in theory software should have an indefinite life span, in practice it does not
- software language can change over time
- software suppliers can become insolvent
- the pace of technological development and user/public expectations can change over time; and
- consequently, some or all the above factors or updates to the system might no longer be possible, making technology updates difficult or impossible.

Commercial managers should consider such factors early in the project life cycle, and understand that any change in the relationship with the supplier might well have a potentially serious commercial impact for the client. They should be confident that their relationship with the supply chain will remain strong going forward.

5.11 Obsolescence

While software becomes obsolete over time it potentially has a comparatively long life span. However, the same does not apply to systems hardware which usually requires regular replacement. The problem facing commercial managers is that, given the rapid pace of technological change, any hardware component needing to be replaced because of obsolescence may no longer be available to the original specifications. The replacement of one component with an identical part is normally straightforward, but if the specification for the component has changed over time then there may be a need for considerably more testing, and at great expense to the client.

Obsolescence management should be considered early in the project life cycle, and commercial managers should ensure that the contractual relationship with the supplier is robust enough to support any required changes. They should regularly ensure that they are aware of:

- who will be responsible for managing and dealing with issues of obsolescence
- whether the project ensures a sufficient quantity of replacement components
- who will predict when hardware will require replacement
- what happens if the replacement of obsolescent components or parts does not work
- who will be responsible for rectifying this failure
- opportunities to save the client money; and
- entering into a contractual arrangement at the start of a project which deals with replacements and spares, to avoid negotiations at a later stage where the client may have no leverage.

Commercial managers, and their successors on any major programme, should always ensure that any product replacement decision is underpinned by a strong business case for undertaking the work. They should plan any change process in advance, and remain aware that changing any part of a digital system incurs risks, both operational and financial. Any changes to the system should be accompanied by a rigorous testing regime that can be conceived of as analogous to a delivery strategy.

5.12 Cyber security

All connected information systems are vulnerable to cyber-attacks which may be designed to inflict damage to, or illegally obtain information from, the hardware, the software and the data stored on them. Once weaknesses in a system or its underlying components are exposed, these become known very quickly.

Commercial managers should view system protection as a form of health care that itself carries specific risks:

- supplier/sub-supplier updates to any system designed to make it current can generate vulnerability while doing so
- any change to a digital system can also create vulnerability; and
- any changes potentially affect system stability, and may require significant testing to ensure safe deployment.

Commercial managers should consider who will manage the security of any digital system, and be responsible for ensuring it is up to date and functioning effectively. They should also remain constantly aware of what the consequences of any healthcare might be.

Systems security, and subsequent changes made during the operational phase, should be tested rigorously and the business case for such testing should be made clear to the client. Commercial managers should be aware of who has responsibility for systems security, how many updates are required, how many tests will be needed to guarantee systems security and what levels of vulnerability remain in the system. They should ensure that the systems security supplier is clear about their role, about who will manage and quantify any risks to the system and about the supplier's ongoing level of commitment to the project. It should be noted that if for any reason a supplier is unwilling or unable to perform the above tasks, then this will generate considerable risk for the client.

Case Study 2 – Transport for London and the Prestige Contract

Context

TfL's Oyster Card electronic ticketing system was an immediate success following its introduction across the UK capital's transportation network between 2002 and 2006. As the largest smartcard, operational system in the world, Oyster allowed its users to 'touch and go' across the capital, and proved largely reliable while simultaneously reducing fraud and lowering costs for end users. It also proved very popular, with 80% of all public transport journeys in London being undertaken via Oyster by 2012.

The new ticketing system had been supported by a clear and compelling business case that included:

- the replacement of outdated and expired equipment
- the modernisation of a partially gated Underground network on which there were substantial levels of ticketless travel
- the need to eliminate increasingly large queues at ticket offices and gates
- a requirement to improve boarding times on buses to reduce dwell times at bus stops
- the transforming of limited ticket integration capabilities, and the need to introduce more flexible ticketing products across the network; and
- an improvement in the levels and quality of management information.

However, despite the clarity of the business case, delivery of the new system proved to be difficult, given that TfL were not simply looking at introducing further ticketing innovation across the capital's transport networks. Beyond this requirement, TfL also aimed to reduce transport costs, expand existing services and develop new technologies that would further improve the overall customer experience.

Contract limitations

The Oyster Card system had been delivered under the terms of the 'Prestige' contract. Prestige was an early and successful example of the UK's Private Finance Initiative. It was concluded between TfL and Transaction Systems Limited (TranSys), a special purpose supplier whose main shareholders and subcontractors were an asset provider, Cubic, and an operator, EDS, along with other minor shareholders and funding partners. The contract, initiated in August 1998, was both complex and hugely detailed, and included the following key terms:

- Seventeen-year contract terms subject to the following early termination provisions:
    - o TfL had the capacity to terminate the contract early if TranSys defaulted on its contractual obligations.
    - o TfL could terminate the contract with one full year's notice, although this would entail paying any outstanding debts it owed to TranSys because of the contractor's investment in the system.
    - o By giving two years' notice TfL could terminate the contract at the 12-year stage (August 2010), and simply repay the TranSys investment plus interest.

A set of performance measures established at the point at which the contract was awarded, but characterised by limited opportunities to revise the terms without comprehensive renegotiation.

No systems integration or interfacing provisions that would easily permit new relationships with third party suppliers of systems or equipment.

Limited provisions for the handback of the system at the point of contract expiry to enable continued use and competition.

In intellectual property terms, the Prestige contract:

- Gave ownership of all physical assets to the contractor until the end of its term, at which point they would pass to TfL.
- Allocated ownership of all IP to the contractor in perpetuity, and at the contract's end TfL would receive licensing arrangements allowing them to use the technology in perpetuity.
- Did not set out any requirements for the structure, comprehensiveness or completeness of the tangible IP.
- Only permitted a clear IP escrow release event at the point of contract termination.
- Did not specify who had ownership of the 'Oyster' brand name.

It was also clear that the Prestige contract would not be easy to renegotiate. The system performance originally contracted for did not satisfy either TfL's current or future needs, and there were also governance issues. TranSys was effectively controlled by Cubic and EDS, whose mutual business interests were not particularly well aligned. Furthermore, as far as Cubic were concerned, London constituted a key market, whereas for EDS the TfL contract was not a priority objective given their far larger global portfolio. Also, having delivered the original Oyster contract, TranSys had little additional incentive to offer any further innovation.

Terminating Prestige

Negotiating TfL's termination of the Prestige contract proved difficult and, given its nature, politically sensitive. For TfL, any future plans to introduce competition or any new ticketing technology across the London network, hinged on their ability to secure a transfer of IP from TranSys. Without a full working knowledge of the Oyster system's technical specifications, any new competitive tender with the objective of further modernising ticketing arrangements would be difficult to achieve in either the timescales, or the cost envelope that TfL required.

The issue was that the Prestige contract did not make it clear whether TranSys had any obligation to share the IP for the Oyster system which was a complex, bespoke ticketing facility designed specifically for London's 'legacy' transport network. Moreover, even if TfL secured the technology specifications, it was likely that these would not be easy for a third party to understand or utilise, thus enabling a competitive tender that would then lead to the appointment of a new, alternative provider.

Developing the roadmap

To explore alternatives and identify the best arrangements for any future supplier relationship, TfL created a requirements and decision making roadmap. At the heart of this exercise lay a set of principles that embodied key changes TfL required as the foundation for any route forward. It was evident that a commercial premise needed to be established for any future discussions to prove fruitful. This premise included a progressive plan to transform the traditional and adversarial commercial relationship with TranSys into a more collaborative and transparent one. Simultaneously, a clear sense of what the future supplier relationship would look like (in both positive and negative terms) was also arrived at.

Once the roadmap had been established, TfL entered discussions with TranSys, Cubic and EDS that focused on the renegotiation of the existing Prestige contract in a way that would allow for the incorporation of the key commercial principles into any new contractual arrangement. Since any renegotiation fell within the remit of either Cubic or EDS, TfL decided that it would be more productive to undertake separate discussions – conducted at a different pace – with each.

At a critical stage in the resulting discussions TfL elected to inform both Cubic and EDS that they intended to make use of the contractual break clause, and that they planned to activate this by 13 August 2008. The key principle underpinning the conversations with Cubic was the need for an agreement to obtain access to their IP, although TfL were aware that holding onto this had been at the core of the contractor's corporate strategy for several years. By contrast, the key principle that TfL applied to the EDS discussions was a request for a major improvement in value for money, largely through a reduction in costs. By December 2007 it was clear that Cubic were prepared to negotiate an IP restructuring, verification and transfer to TfL.

Unfortunately, EDS did not respond favourably to TfL's need for cost reduction, which subsequently, led the latter to conceive of a new plan based on the idea of exercising the break clause before then moving toward a three year 'bridge' contract with Cubic. This contract would allow for an IP transfer to be undertaken, and lead to a more robust handback programme that would enable a competitive tender.

Two Oyster system failures on 12 and 25 July 2008 added considerable political weight to TfL's rationale for wishing to terminate the Prestige arrangement. Therefore, on 30 July the TfL Board authorised the termination of the Prestige contract in August 2010. This decision provided the impetus to negotiations with EDS and included a £1 million payment from TfL to TranSys for the Oyster brand, and a subcontract from Cubic for EDS for a proportion of their existing services.

The contract with Cubic enabled TfL to transition the Oyster system without any disruption to their customers, while also permitting the substantial restructuring, verification and transfer of all tangible IP to the organisation's own internal IP repository. TfL modularised and supplemented the system with new, additional materials and subsequently independently verified it to confirm that it was suitable for use by a third-party contractor. It was this IP that formed the core of the data for the open market competition which followed. The new contract which resulted from this also included greater cost transparency and value for money provisions, which in turn allowed for substantial reductions in the delivery costs of TfL services.

Lessons learned

To deliver best value, respond to changes in customer needs and take advantage of changes in technology it is essential that the client organisation frames any digital system procurement within the framework of their own technology strategy and retains sufficient internal knowledge to properly challenge and manage the supply chain. The client and supplier objectives need to be aligned, and that alignment needs to be maintained through actively identifying and creating commercial leverage. Time spent planning not only the development, delivery and operation of the system but also its handback or decommissioning, will ensure early identification of risks and issues and enable the appropriate commercial strategy to be adopted.

The interim arrangements enabled TfL to better understand the Oyster system itself, and they were also able to create their own internal technical capability which, ultimately, culminated in the development of key back office components. Ultimately this led to the successful introduction of contactless payment cards, and further improvements in the TfL transportation experience for customers.

6 Summary

This guidance note looks to provide early insight into the increasingly important contribution of digital technology to the design, development, implementation and operation of modern economic infrastructure assets. It sets out the aspects to be considered by commercial managers in providing effective commercial stewardship in the design, procurement, delivery and operational management of the digital and technological aspects of major programmes. It also draws on historic 'step changes' in the expectations of commercial managers regarding evolving 'specialist' markets, and highlights that we are on the cusp of a new emerging market – the digital and technology market - which will have a significant impact on the viability and business case of future infrastructure investment.

This guidance builds on the previous note in this series – *The Role of the commercial manager in infrastructure* – and shows how commercial managers should apply the delivery of 'value' within the digital and technology market. It presents a 'snap shot' of early thinking on the growing and increasingly important digital and technology market, setting out best practice for RICS members responsible for commercially managing infrastructure, its technology and the associated supply market.

In terms of commercial management in this arena, every aspect is in its infancy, from market knowledge and insight to the absence of language and techniques to inform what the digital and technology aspects of infrastructure investment, should, will, did cost and why. It is a fast-evolving market within the infrastructure sector and the guidance steering group and author have sought to produce a document, effectively the first of its kind, to provide guidance on best practice for infrastructure commercial managers.

It looks at key areas such as product selection, the commercial management of IP and IPR, systems integration, the testing process and whole life costing. It thus provides insight that will ensure professionals engaged by infrastructure clients can offer informed, value based decision making to support effective commercial stewardship.

The note has been generously sponsored intellectually by TfL, who we thank for their considerable efforts in supporting this project, and Network Rail for insight to the challenges associated with the Digital Rail Programme.
While this may give digital technology and systems a 'rail' focus, we would stress that the commercial management principles set out here can be applied across all areas of economic infrastructure, and indeed globally.

7 Endnotes

1 https://www.networkrail.co.uk/our-railway-upgrade-plan/digital-railway/

2 *Digital Opportunity: A Review of Intellectual Property and Growth,* An Independent Report by Professor Ian Hargreaves (May 2011).

3 RICS professional guidance, UK, *The role of the commercial manager in infrastructure* 1st edition, January 2017, p.19.

4 H.M. Treasury, *The Orange Book Management of Risk - Principles and Concepts* (October 2004), p.7.

5 RICS, *The Role of the commercial manager in infrastructure*, p.11.

Confidence through professional standards

RICS promotes and enforces the highest professional qualifications and standards in the valuation, development and management of land, real estate, construction and infrastructure. Our name promises the consistent delivery of standards – bringing confidence to markets and effecting positive change in the built and natural environments.

Americas

Latin America
ricsamericalatina@rics.org

North America
ricsamericas@rics.org

Asia Pacific

ASEAN
ricsasean@rics.org

Greater China (Hong Kong)
ricshk@rics.org

Greater China (Shanghai)
ricschina@rics.org

Japan
ricsjapan@rics.org

Oceania
oceania@rics.org

South Asia
ricsindia@rics.org

EMEA

Africa
ricsafrica@rics.org

Europe
ricseurope@rics.org

Ireland
ricsireland@rics.org

Middle East
ricsmiddleeast@rics.org

United Kingdom RICS HQ
contactrics@rics.org

rics.org

FEB2018/RICS/UK