Raising our game:
how project managers can better integrate sustainability into infrastructure projects

Sustainability Scholarship 2017

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Contents

1. Abstract

This research argues that there has been an insufficient focus by the project management community on the integration of sustainability into infrastructure construction schemes and that given the social, economic and environmental challenges the world faces, the physical impact infrastructure has and the significant amount of money being spent in the coming years worldwide, project managers must step up and take the lead in meeting this challenge. This research uses UK railway infrastructure construction as an example of understanding the maturity of projects around integrating sustainability, what the barriers are and how they can be overcome.

2. List of Tables and Figures

3. Glossary of Abbreviations and Definitions

4. Acknowledgements

[complete at end]

- CIOB< Worshipful, CEM, Gina, Bob, Francine

- Timothy Milford
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5. Introduction

‘”the project management profession requires project managers to take responsibility for sustainability” (McKinlay 2008)

5.1 Background and problem

This research argues that there has been an insufficient focus by the project management community on the integration of sustainability into the project management of infrastructure schemes and that given the social, economic and environmental challenges the world faces, the physical impact that infrastructure has and the significant amount of money being spent in the coming years worldwide, there is a need for the project management community to step up and take the lead in meeting this challenge.

5.2 Research aim and objective

This research therefore seeks to better understand the barriers that prevent infrastructure project managers from integrating sustainability into the project lifecycle and make recommendations to o overcome them.

5.3 Focus of the study

Given the scale of potential research in infrastructure projects across the world, this report will focus on UK railway schemes and the associated project management community, given the national scale and amount of funding they receive.

5.4 Research layout

5.4.1 Literature review

[Include summary]

5.5 Research methodology

5.5.1 Current project maturity levels

The first part of the research looked at the extent of how mature railway projects are at incorporating sustainability. This was undertaken in three parts:

- Understanding the level of knowledge that a representative sample of project managers has around sustainability;
- Understanding the extent to which a representative sample of projects embed sustainability into their lifecycle; and
- Understand the barriers that prevent project managers from integrating sustainability.

5.5.2 Understanding of what needs to change

The second part of the research sought to understand what needs to happen to allow project managers to improve. This comprised three elements:

- Setting out the high level enablers that project managers should undertake in order to embed sustainability into infrastructure schemes;
- Establishing the benefits and dis-benefits of embedding sustainability; and
- Defining measures that infrastructure project managers could use to measure progress and understand how to realise benefits.

5.6 Research findings

[summary]

5.7 Conclusions

[summary]

5.8 Recommendations to industry

5.9 Assumptions made throughout the research

[add back in at end]

5.10 Constraints within the research

- The projects studied in this research vary in scope, scale and cost and are at different stages within the project management lifecycle. As such, there invariably be differences of perspective from each of those involved within the schemes.
- The research does not look at the maintenance of assets; it is focussed those that are enhancing the network and taking place within the infrastructure projects section of the business.
- The study has only looked at the lifecycle of the project itself and not gone beyond that.

6. Sustainability, infrastructure and project management literature review

This section looks at the three key themes of this study; the growing profile of sustainability, the development of infrastructure sustainability and the associated need for more and better project management.

6.1 The rising profile of sustainability

Sustainable development is a broad concept that encompasses a wide range of issues relating to development, equity and environmental policy (Markandya and Halsnaes, 2002) and striking a balance between economic growth and social wellbeing has existed as a political and managerial challenge for over 150 years (Dyllick and Hockerts 2002).

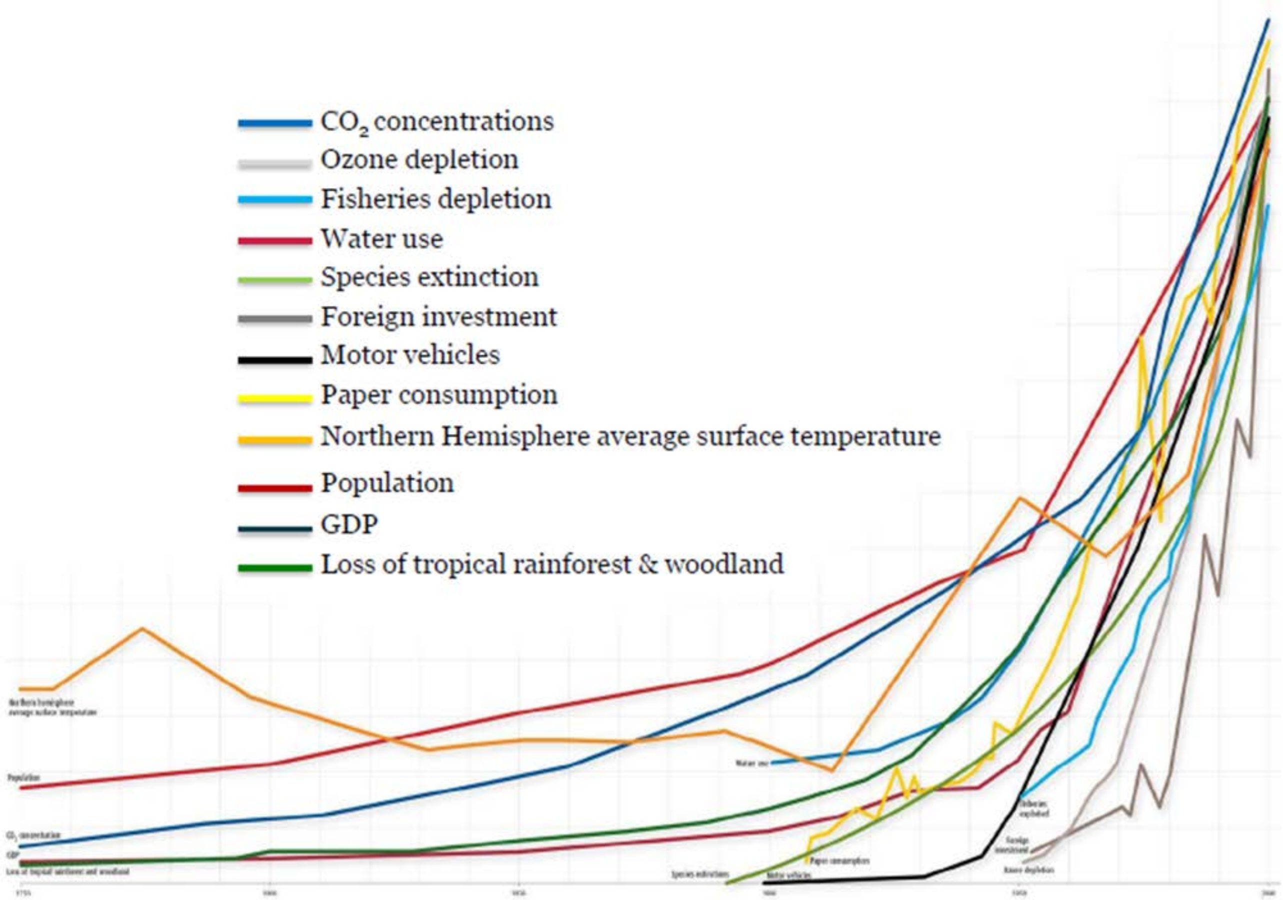
An increased concern at the intense development of some countries at the expense of others led to an increased focus in the 1970s and gained higher profile when the Brundtland Commission declared in the late 1980s that humans have the "ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (Bruntland, 1987). In effect, this was saying that there is a partnership between the environment and the economy (OECD, 1990) and the principles were further developed at the 1992 Rio de Janeiro United Nations Conference on Environment and Development. Further work in the 1990s saw the advent of the "triple bottom line" concept, which took into account social and environmental performance alongside the traditional accounting measurement of finance (Elkington, 1997).

The turn of the millennium heralded a further call to action around ensuring "energy efficiency, affordability and accessibility…of long-lived energy consuming infrastructures, such as the public sector, transport, industry, agriculture, urban land use, tourism and construction sectors" (United Nations ??) in response to the challenges of accelerated growth across a number of indicators as highlighted in Fig. 6.1. In 2015, heads of government announced a new set of seventeen sustainable development goals, which was known as Agenda 2030 (Fig.

Agenda 2030: The UN Sustainable Development Goals

Following the adoption conclusion the Paris Agreement on climate change at the end of that year, which set a target of keeping the global temperature below 2 degrees Celsius by 2100, it was concluded that companies now had a strategic choice between being part of a well-planned and managed global transition or being subject to a more disruptive transition – both at the company and broad economy level (CISL, 2016).

Figure 6.2 Global trends from the 1750s to the 2000s (Steffan et al, 2004)



6.2 Global trends

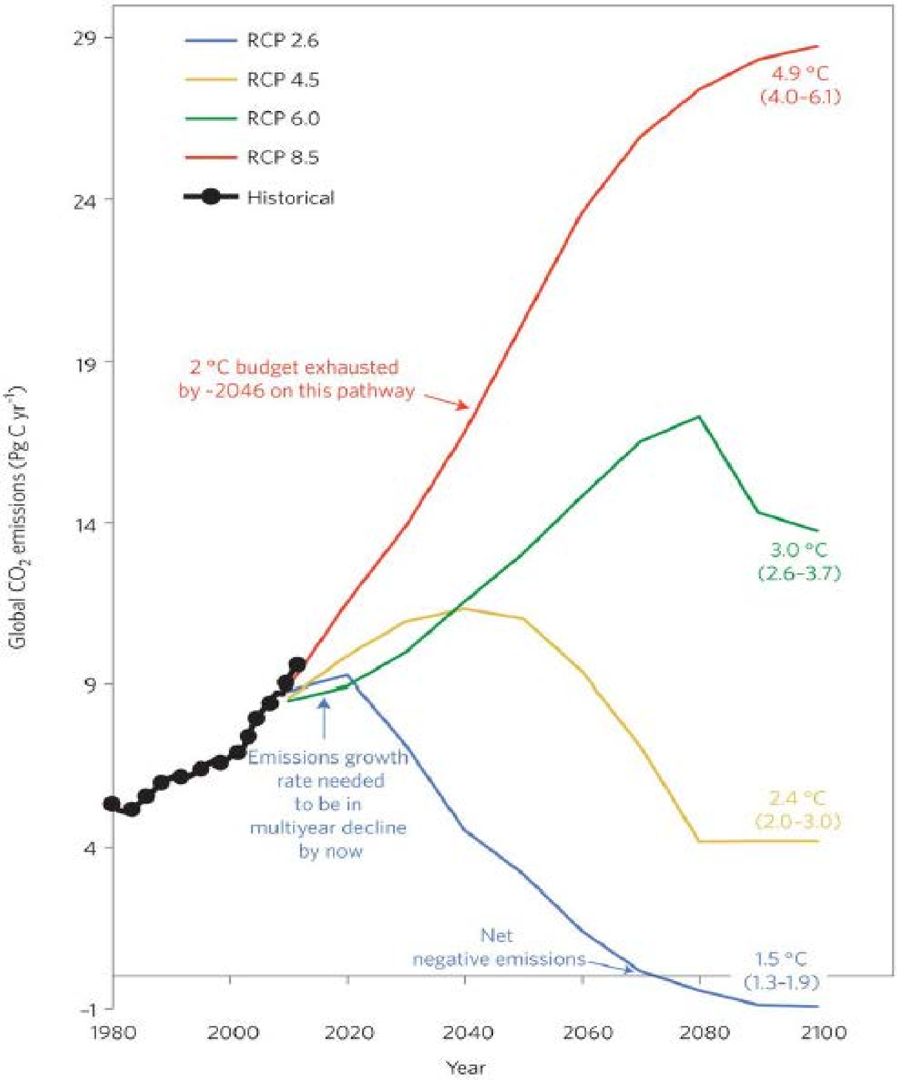
There are a number of global trends (CISL, 2016) that will have a likely impact on the construction of infrastructure in the coming years, such as:

- Policy makers beginning to focus on climate change;
- Societies increasingly adopting sustainability targets;
- Regulators playing an increasing role;
- Accelerating technological change;
- Major utilities beginning to change policy; and
- Increasing financial pressures on worldwide supply chains.

6.2.1 Infrastructure will be directly impacted by climate change

Climate change scenarios highlight that on the current trajectory, limiting global warming to 2 degrees Celsius by 2100 looks almost impossible and therefore infrastructure needs to become more resilient to meet this global change. Fig. 6.2 demonstrates this challenge by outlining a series of scenarios around concentration of carbon in the atmosphere and subsequent temperature rises (RCP).

Figure 6.3 Global temperature rise scenarios (Sanford et al, 2014)



6.2.2 Growing sustainability risks

The World Economic Forum Global Risks Report 2017 has charted the move from primarily economic concerns in the late 2000s towards greater social and environmental risks and impacts as set out in Fig 6. The trends underlying these risks were:

- Rising income and wealth disparity
- Changing climate
- Increasing polarisation of societies
- Rising cyber dependency
- Ageing population

The Evolving Risks Landscape, 2007-2017 (WEF, 2017)

When looking at most important risk interconnections, the following were identified:

Issue	Connected to
Unemployment and underemployment	Profound social instability
Large-scale involuntary migration	State collapse or crises
Failure of climate change mitigation or adaption	Water crises
Failure of national governance	Profound social instability
Interstate conflict with regional consequences	Large-scale involuntary migration

6.3 The impact of infrastructure

Infrastructure accounts for approximately 53% of UK greenhouse gas emission and the government has committed to reduce greenhouse gas emissions by 50% in 2025. (CLC, 2016) With significant investment taking place over the coming years, it is important to have a framework in which to measure the role of sustainability.

6.3.1 UK infrastructure sustainability

As it accounts for 12% of UK construction sector output, infrastructure is the key sector to have an impact on capital carbon impact due to the raw materials that it procures. The evidence suggests that the lower the carbon output, the lower the costs to industry (HMG, 2013).

The strategy concluded that there is work to do in providing greater clarity around what the sustainable construction opportunities are. However, the new government formed in July 2016 has moved away from the use of sustainable development indicators and is currently considering how to implement the UN Sustainable Development Goals. It therefore provides very little direct drivers around meeting sustainability targets, with no specific national metrics in place (ONS, 2016).

6.3.2 World spend

Infrastructure schemes have been growing by 1.5% to 2.5% annually in real terms over the past century, which equates to a doubling in project size two to three times per century (Flyvberg, 2014). The McKinsey Global Institute estimated in 2013 that the global requirement for infrastructure expenditure will be $3.4 trillion between 2013 and 2030, accounting for approximately 4% of total global gross domestic product, mainly delivered as large-scale projects. Not at any time in the history of mankind, has infrastructure spending been this high, measured as a share of world GDP (Economist 2008, June 7, p80 Building BRICS of growth). Even in downturns, infrastructure has been remarkably resilient to the recession with stimulus spending being spent on transportation infrastructure.

6.3.3 UK spend

In the UK, the planned infrastructure pipeline that was published in early 2016, highlighted that there were 602 major projects (costing over £50m) with a combined value of £483bn (2014/15 prices) with transport accounting for 329 projects and £134bn up to 2020/21 and beyond.

(Infrastructure and Projects Authority, 2016). Given that 37% of these schemes are publicly funded (Rhodes, 2016), they are highly attractive politically and economically because they benefit many sectors, technologically because they push boundaries and also aesthetically because of the pleasure they get from something well designed and iconic.

6.3.4 Investment criteria

Under the current investment criteria for investing in schemes, sustainability does not directly feature, however there is opportunity for its inclusion around three of the criteria:

- Projects must have a high potential contribution to economic growth, with particular emphasis on increasing productivity and enabling innovation.
- Investment must deliver, enhance or replace infrastructure of national importance.
- Projects must attract significant private sector investment.

6.3.5 Defining sustainable infrastructure

Defined as a set of structural elements that supports the day to day function and influences the direction of human society (CRC, 2016) and the fundamental foundation upon which a society exists, develops and survives (Venegas : 2003), sustainable infrastructure development has been defined as achieving a balance between several objectives (environmental, economic, and social) over dynamic time and spatial horizons (Sahely et al, 2005).

The Royal Academy of Engineering (2005) elaborates on this by setting out that:

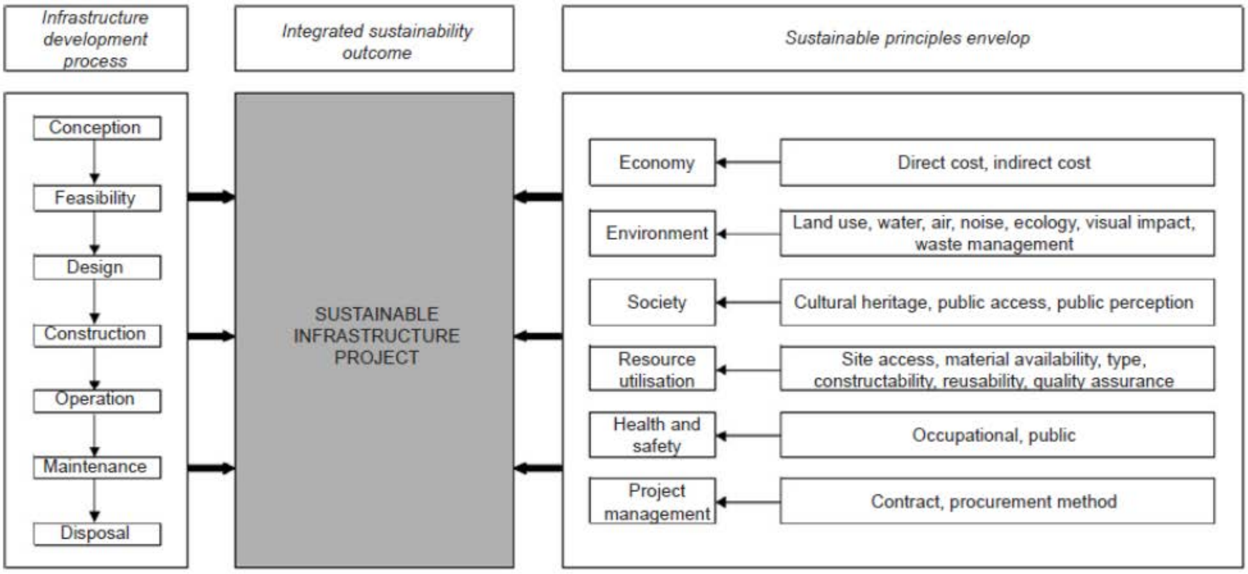
"Infrastructure sustainability is about balancing triple bottom line trade-offs, and extends beyond just addressing ecological concerns. However, it is "not simply a matter of trading off positive impacts in one area against negative impacts in another. A successful development builds on the three pillars and achieves economic success, social benefit and high environmental quality together".

6.4 Bringing the two concepts together into a framework

In order to achieve sustainable infrastructure, there needs to be consideration of environmental (resource use and waste management), economic (capital, operations, maintenance costs, and innovation), and social (performance, accessibility, acceptability, and health and safety) aspects

(Sahely et al, 2005). Yim and Lang (2006) developed a conceptual framework to determine six elements that a sustainable infrastructure scheme must include (Fig. 6.5).

Figure 6.5 Sustainable infrastructure framework (Lim and Yang, 2006 in Willetts et al, 2010)



6.5 Measuring project sustainability

Envision and BREEAM wording to be included

6.6 The rise of project management

6.6.1 The management of infrastructure schemes

Infrastructure schemes are generally managed as projects and there has been a worldwide trend over the last century towards the role of managing through projects. Furthermore, there is a growing trend towards 'mega' projects that are defined as

"large-scale, complex ventures that typically cost 1 billion US dollars or more, take many years to develop and build, involve multiple public and private stakeholders, are transformational, and impact millions of people." (Flyvberg, 2014)

They are also designed to change the structure of society and are increasingly being used as a vehicle in infrastructure e.g. high speed rail lines, airports, seaports, motorways, the Olympics, dams, wind farms, offshore oil and gas extraction. (Flyvberg, 2014).

6.7 Referencing of sustainability in project management literature

The challenge faced by the project management community is that sustainability is predominantly conceptual, rather than practical (Pope et al. 2004).

Whilst much of the current project management literature states that it is a complex yet growing topic, there is little to direct project managers about how they can lead this agenda. The literature also shows that there is a small but growing amount of information around sustainability in infrastructure and instead generally focusses on smaller scale schemes, such as buildings.

In some respects, the addition of sustainability to the project management agenda is not a surprise to Dalcher et al (2012) who point out that there are tensions between sustainable development and project management, as highlighted in Fig 6.6

Figure 6.6 Contrasts between sustainable development and project management (Dalcher et al, 2012)

Sustainable Development		Project Management
Long-term + short-term oriented	↔	Short-term oriented
In the interest of this generation and future generations	↔	In the interest of Sponsor/Stakeholders
Life cycle oriented	↔	Deliverable/result oriented
People, Planet, Profit	↔	Scope, Time, Budget
Increasing complexity	↔	Reduced complexity

However, the topic is gaining traction and the UK Association of Project Management has a section on sustainability in its Project Management Book of Knowledge, (Ref from personal copy), although it is in the final section in the book and acknowledges that the concept is a simple one that is very difficult to put in practice and therefore as a guidance organisation for project management, there is not yet any clarity around how to put the concept in practice.

Taylor elaborated on his earlier appeal to the project management profession (Association for Project Management 2006), by publishing A Sustainability Checklist for Managers of Projects (Taylor 2008) and a book on Sustainability Interventions for Managers of Projects and Programmes (Taylor 2011). Taylor takes on a very practical approach and both publications contain lists of potential considerations and interventions that can be used for understanding the sustainability aspects of projects. Although the checklists lack a systematic approach to the concepts of sustainability, they are meaningful tools for translating the somewhat abstract concepts of sustainability to the daily work of the project manager.

6.8 Project lifecycle management

In what was one of the earlier works linking the two concepts of project management and sustainability together, Labuschange and Brent (2006) coined the concept of sustainable project life cycle management (social equity, economic efficiency and environmental performance). Whilst their focus was on manufacturing, they argued that the future-orientation of sustainability implies that the full life cycle of a project, from its conception to its disposal, should be considered.

6.9 Who should take the lead?

Eid (2009) concluded that project managers still fail to seriously address the sustainability agenda (Eid 2009), whilst Silvius (2010) undertook a study that looked at the person within a project who is best placed to drive sustainability. The conclusion (Fig 6.6) was that it was the place of the project manager in most instances.

Figure 6.7 Who is responsible for integrating sustainability? (Silvius, 2010)

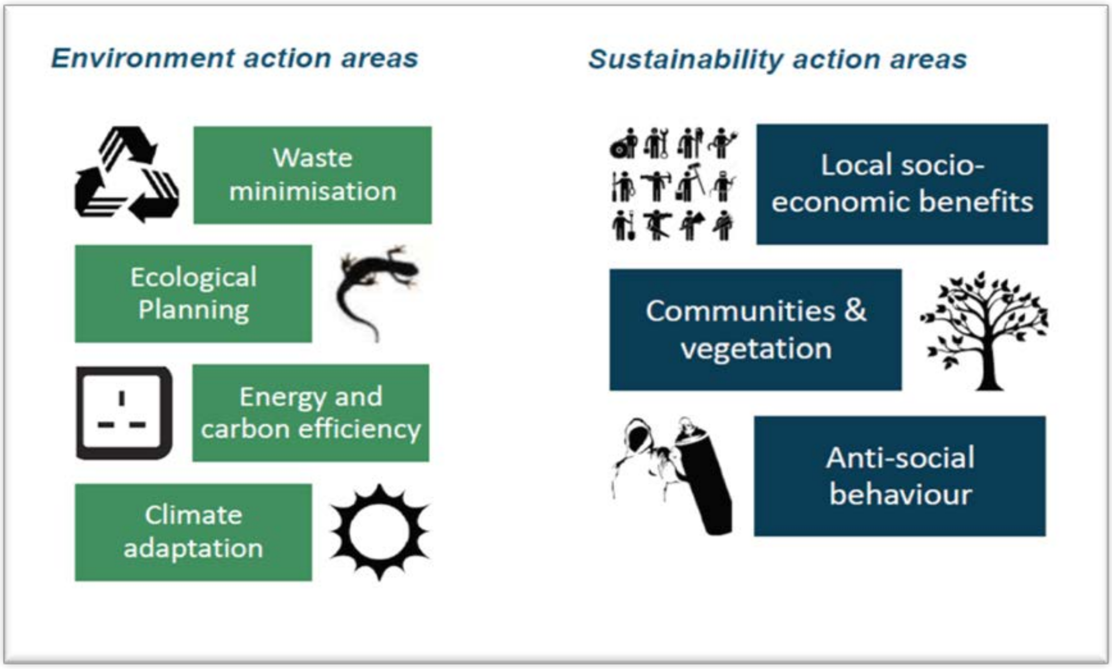
		Project context				Project team			Operations
		Project sponsor	Portfolio manager	Program Manager	Senior user or Senior supplier	Project manager	Designer/ architect	Construction/ realisation manager	Project user
Economic Sustainability	Return on Investment	is responsible for	can influence	can influence	can influence	can influence	can influence	can influence	can influence
	Business Agility	can influence	can influence	can influence	can influence	is responsible for	is responsible for	can influence	
Environmental Sustainability	Transport	responsible or can influence	can influence	can influence	can influence	responsible or can influence	can influence		
	Energy	responsible or can influence	can influence	can influence	can influence	responsible or can influence	responsible or can influence	can influence	can influence
	Waste	can influence			can influence	responsible or can influence	is responsible for	is responsible for	can influence
	Materials and Resources	responsible or can influence			can influence	responsible or can influence	is responsible for	is responsible for	can influence
Social Sustainability	Labour Practices and Decent Work	responsible or can influence	can influence	can influence	can influence	is responsible for	can influence	is responsible for	is responsible for
	Human Rights	responsible or can influence	can influence	can influence	can influence	is responsible for	can influence	is responsible for	is responsible for
	Society and Customers	responsible or can influence	can influence	can influence	can influence	is responsible for	can influence	can influence	can influence
	Ethical Behaviour	responsible or can influence	can influence	can influence	can influence	is responsible for	can influence	is responsible for	is responsible for

The conclusion of Fenner et al., 2006; Gambatese and Rajendran, 2005) is that for the infrastructure sector to realise its potential in sustainability, it will require a shift away from the traditional project objectives of cost, time and quality and develop solutions that are suitable to meet these three needs.

6.9.2 Rail infrastructure sustainability

The railway network generates £10bn for the UK economy each year (Oxera, 2014) and there is a growing focus on sustainability in railway construction with a sustainability strategy (summarised in Fig 6.7) serving as a focus for Network Rail.

Figure 6.8 Network Rail Sustainability Priority Themes



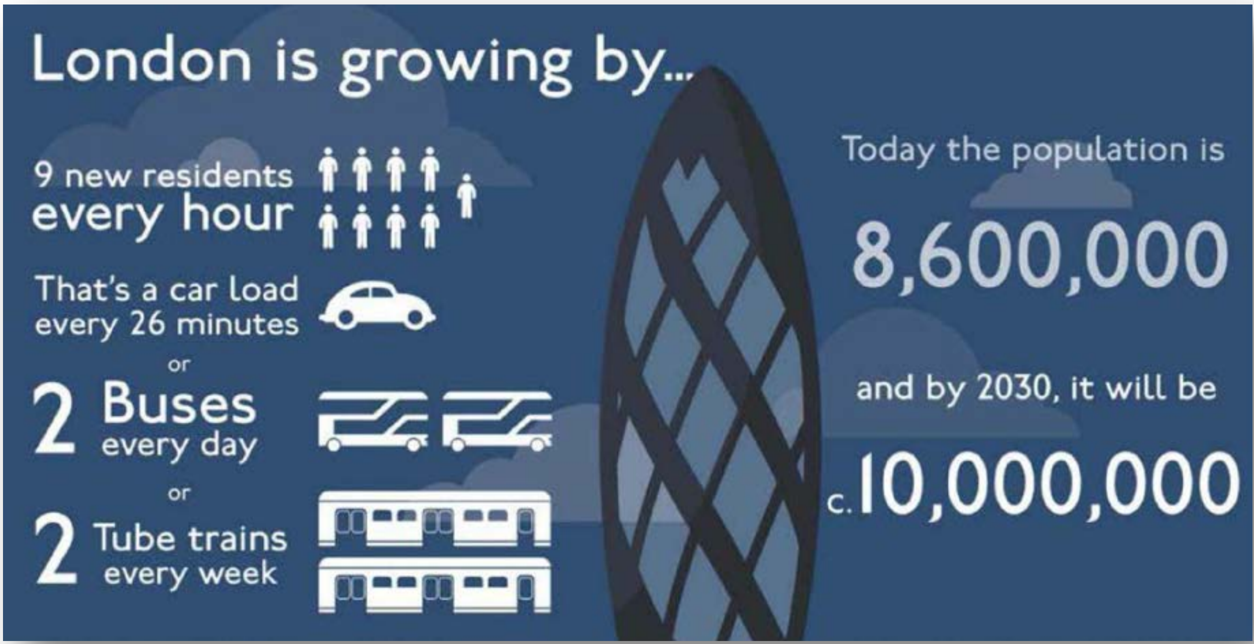
6.10 Crossrail 2

One such mega project is Crossrail 2 and forms part of a wider UK government investment in infrastructure. If the scheme were a standalone economy, it would have the 128th biggest GDP in the world, on a par with that of Cyprus and would equate to 1% of UK GDP.

and the £134bn of planned investment means that these schemes can be major drivers of sustainability. The rail industry is currently halfway through a committed funding pipeline of £15bn up to 2019.

London's population continues to grow (Figure 6.5) rapidly recorded at 8.2 million in the 2011 Census and expected to rise a further 20 per cent to 10 million by 2030 and therefore providing the right number and type of homes that will enable all people to live and work is critical (Arcadis, 2016).

Figure 6.9 Crossrail 2 responding to the growth challenge



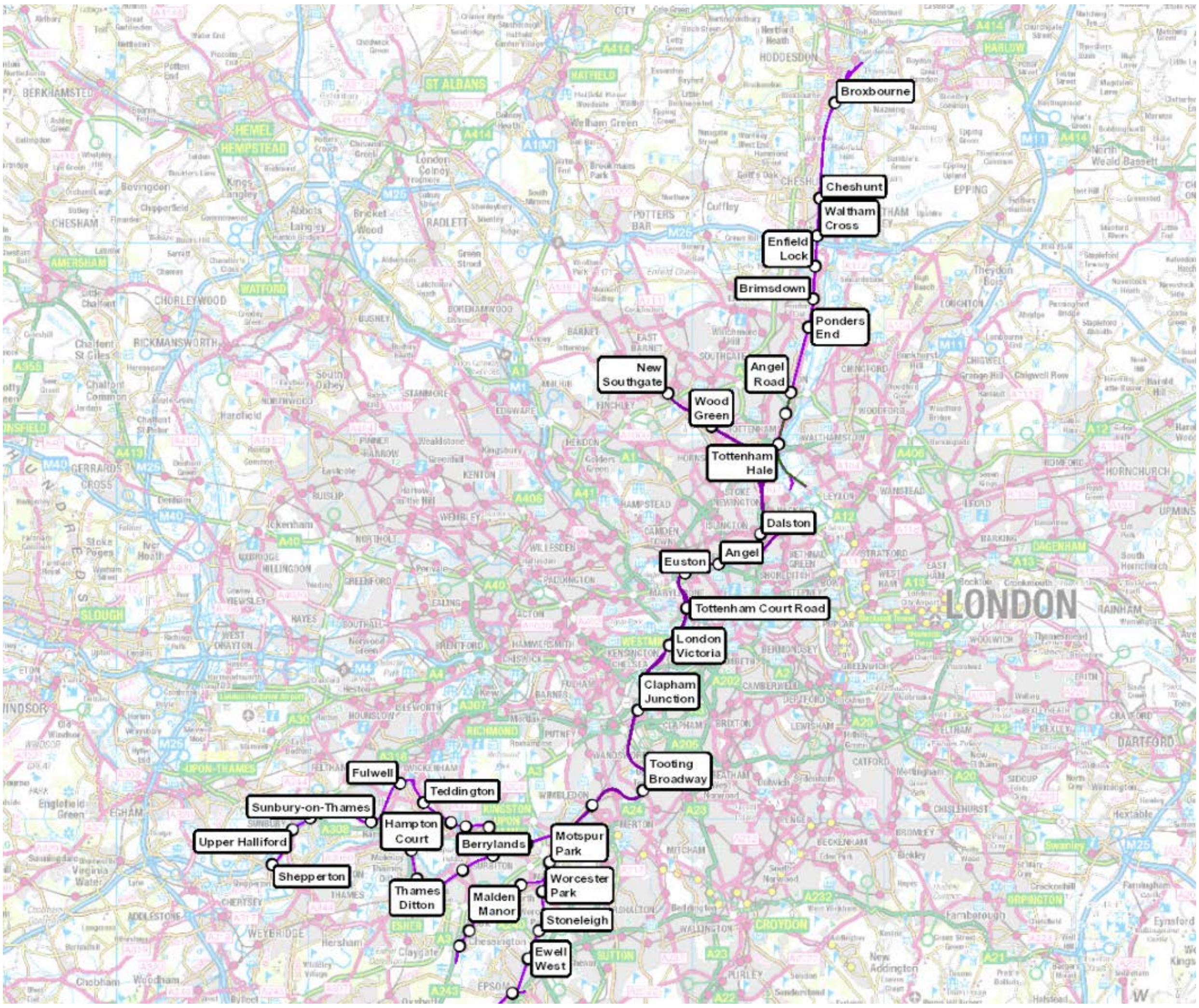
Source: Transport for London

- Support growth, skills and employment
- Provide a carbon smart and climate resilient scheme
- Enhance the natural and built environment
- Build and operate a resource efficient scheme
- Support a safe, secure and healthy city
- Support sustainable communities

6.10.2 Crossrail 2 – the professional challenge

CR2 is a proposed new high-frequency, high-capacity rail line running through London and into Surrey and Hertfordshire. The new line will add capacity to the rail network in London and the south east as well as support economic regeneration by providing the infrastructure needed to build new homes and create jobs.

Figure 6.10 Geographical extent of Crossrail 2



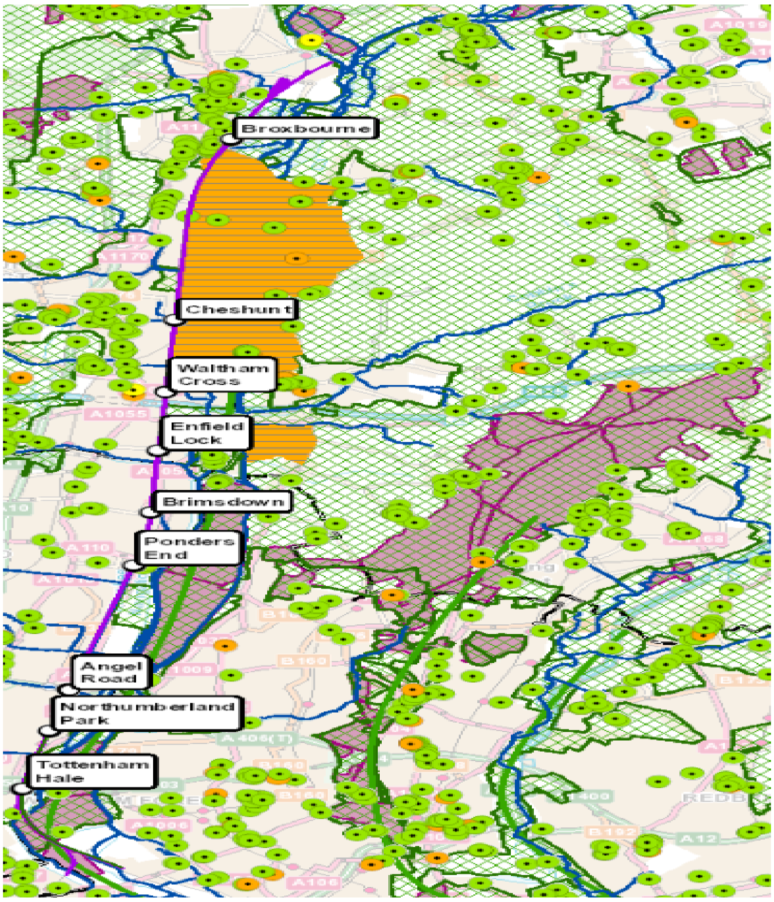
6.10.3 West Anglia sustainability challenges

How to integrate sustainability into Crossrail 2 is most starkly highlighted in the northern part of the route up the West Anglia Mainline where there are myriad sustainability challenges, some of which are outlined in Fig. 6.10 which highlights:

- Listed buildings
- Flood plains

- Country parks
- Main rivers
- Green waling corridors
- Green belt
- Open spaces
- Sites of Special Scientific Interest (SSSI)
- Ramsar sites of international importance
- Densely populated residential areas
- Level crossings

Figure 6.11 Crossrail 2 sustainability considerations in the Northern On-Network section



The picture in Fig 6.11 is an aerial view of the West Anglia section of the scheme and the major sustainability challenges It faces.

Aerial view of the proposed Crossrail 2

Source: Lee Valley Regional Park Authority (2016)

7. Research methods

This section details the research approach undertaking by comparing the quantitative and qualitative methods of research, the decision process behind why the qualitative method was deemed most appropriate for undertaking research within the infrastructure project management community and how the method was put into practice.

7.1 Assumptions underpinning the research approach

- The projects being analysed are a mixture of those in the development, implementation or operational phase and therefore have a mixture of projected and actual results;
- The focus of study is on railway projects not take into account any consequential infrastructure projects in a locality that may have occurred as a result of the project e.g. highway upgrades to meet increased travel to and from railway stations.
- The research focussed on the infrastructure project management community in the knowledge gathering stage and was supplemented with sustainability experts once the actions to overcome integration were being identified.

7.2 Quantitative and qualitative research – a comparison

Best and Khan (1989) outline that quantitative research consists of those studies in which the data concerned can be analysed in terms of numbers, whilst qualitative research is principally concerned with collecting and analysing information in as many forms, chiefly non-numeric, as possible (Blaxter, Hughes and Tight, 1996). Tables 7.1 and 7.2 set out the key characteristics of both approaches and an explanation of what they mean in practical terms.

Table 7.1 Quantitative research characteristics (adapted from Burns, 2000)

Characteristic	Explanation
Control	Experiments are conducted in an attempt to answer set questions and identify why something happens, what causes an event, or under what conditions an event occurs.
Definition	Research terms are defined by the way they are measured in order to avoid ambiguity ensure there is no ambiguity (e.g. “noise levels from construction” would be re-written as “noise levels from construction, as measured in decibels between the

	hours of x and x”) in order to give clarity to the term.
Replication	The data must be reliable and the same result found if the study was repeated.
Testing a hypothesis	Subjecting a hypothesis to empirical (observed) testing.

Table 7.2 Qualitative research characteristics (adapted from Ely et al, 1991)

Characteristic	Explanation
Context	Events are understood in the context in which they occur and therefore the research takes place in a specific setting.
No control over events	There is no controls put in place and instead the research is not pre-defined as to what will occur.
Learning from people	The individuals taking part in the research speak for themselves and the research is informed by these people.
Experience in a wide context	Qualitative research understand events in a wider context as opposed to separate variables
There is no set method	Qualitative methods do not have strict research methods attached to them.

7.3 Which method was most appropriate for this research?

In order to decide on the method to adopt for this research, a number of questions were considered that were adapted from Punch (1998):

7.3.1 What is the exact purpose of the research?

The research aims to improve the infrastructure project management capability around leading the integration of sustainability in the project lifecycle.

7.3.2 Will the research make standard comparisons or look at issues in detail?

The research will be looking at a range of infrastructure project across the rail industry in order to identify key trends, barriers and tools needed to improve and therefore will take a broader approach rather than look at each issue in detail.

7.3.3 What sources of literature will be used?

The research reviewed literature on sustainability as a general theme, infrastructure sustainability specifically and the extent to which sustainability is discussed in project management literature. The literature was predominantly qualitative in nature and did not contain large amounts of quantitative data.

7.3.4 What type of research would benefit the project management community?

Whilst the project management community rely on large amounts of data to monitor progress on projects and ensure that benefits are being realised, the greatest benefit will be around the application of qualitative information that gives practical guidance for how to improve performance in sustainability.

7.3.5 What are the time constraints on the research?

The study was undertaken whilst continuing in full time employment and therefore time was limited to private study and that which was allotted during working hours. The project management community studied is spread throughout the UK and therefore it would have been difficult to conduct a major number of in-depth conversations.

7.3.6 Research preference

Having reviewed the scope of definitions for both quantitative and qualitative research and then answered the questions posed above, it was clear that the study benefits from a qualitative approach, for the following reasons:

- Projects are temporary in nature and therefore it is important to understand the context in which they operate and the environment around them at the time;
- The information ascertained from project managers will have taken place in the context of the time and place it occurred and therefore it is difficult to put research controls in place;
- The information available is of a more qualitative nature and the project management community would benefit from recommendations that do not necessarily lend themselves to quantitative analysis; and
- Given the time constraints on research, it is only possible to make standard comparisons across projects and not go into depth for each one.

7.4 Research activities

7.4.1 Current project maturity levels

The first part of the research was undertaken using a questionnaire (see Appendix A) that sought to understand how mature railway projects of varying engineering disciplines and financial values were at incorporating sustainability by understanding

- the level of knowledge that a representative sample of project managers has around sustainability;
- the extent to which a representative sample of schemes embed sustainability into the project lifecycle; and
- the barriers that prevent project managers from integrating sustainability.

7.4.2 Sustainable infrastructure project framework

After gaining a basic understanding of the project, location, engineering discipline, cost and times, the first section of questions sought to test the extent to which sustainability was integrated and was underpinned by an adapted framework that defined sustainability in six areas detailed in Table 7.3.

Table 7.3 Sustainable infrastructure project framework

Sustainability theme	Areas included in the research
Health and safety management	Health and safety of employees and the wider public
Social impacts	Access to travel, general well-being, stakeholder management
Economic impacts	Employment, income, businesses established
Environmental impacts	Bio-diversity, noise, pollution, carbon, landscape, waste
Project management	Innovation, information systems, whole systems approach
Use of resources	Land, labour, materials, plant, water, procurement of goods and services

7.5 A framework to understand the barriers

The next section of the questionnaire looked at the barriers that exist by using an adapted framework developed by Kotter (1995), as well as allowing participants to express other industry-specific barriers that they believe hindered integration. This framework is detailed in Table 7.4.

Table 7.4 Kotter's steps to transformation (Kotter, 1995)

	Areas included in the research
Establishing a sense of urgency	Understanding the extent to which infrastructure project managers have a sense of needing to do something to address the sustainability challenge
Forming a powerful guiding coalition	Understanding the extent to which groups of project managers are committed to undertaking action around sustainability.
Creating a vision	Understanding the extent to which the project management community knows what is meant by a sustainable infrastructure scheme.
Communicating the vision	Understanding the extent to which the guiding sustainability vision has been communicated to the project management community.
Empowering others to act on the vision	Understanding the extent to which project managers of varying levels believe that they can take the sustainability agenda forward.
Planning for and creating short-terms wins	Understanding what sustainability achievements were made within the project during its design and delivery phases.
Consolidating improvements and producing still more change	Understanding what lasting changes were made once the project was finished.
Institutionalising new approaches	Understanding the extent to which sustainability can now be considered 'business as usual' for infrastructure projects.

7.5.2 Determining what needs to change

The second part of the research sought to understand what needs to happen to allow project managers to improve their integration of sustainability. Through the use of a set of questions within the questionnaire and a subsequent workshop with a set of infrastructure project managers and sustainability managers, the research sought to:

- Set out the high level actions that need to take place in order for sustainability to be better integrated into infrastructure schemes; and
- Determine performance indicators that infrastructure project managers could use to measure sustainability progress on their schemes and understand how to realise the benefits.

7.5.3 Comparative analysis

In order to test the research against other construction sectors, interviews were held with xx organisations:

- Sir Robert McAlpine
- The Environment Agency
- The Railway Safety and Standards Board
- Thames Tideway?

7.6 Integrity of the research

In order to ensure good quality research, the principles outlined in Table 7.5 were adopted.

Table 7.5 Ethical research considerations (adapted from EUI, 2013)

Ethical consideration	How this was applied to this research
Honesty	The aims of the research were set out to all participants and their consent was required for use of any material throughout the process of completing the questionnaire and during the follow-up workshop
Trust	All participants were assured of confidentiality and permission was sought for use of data where individual projects would be identified.
Fairness	All participants in the research were made clear of what my aims were and how their information would be used.
Respect	All participants were treated with respect for their time, views and knowledge when participating in the research
Responsibility	All of the research was undertaken with integrity in making a genuine contribution to the construction industry and not plagiarising other works
Legality	Confidentiality of information was a key tenet of this research
Communication	This research will be published to and is widely available to the construction industry and others

8. Research findings

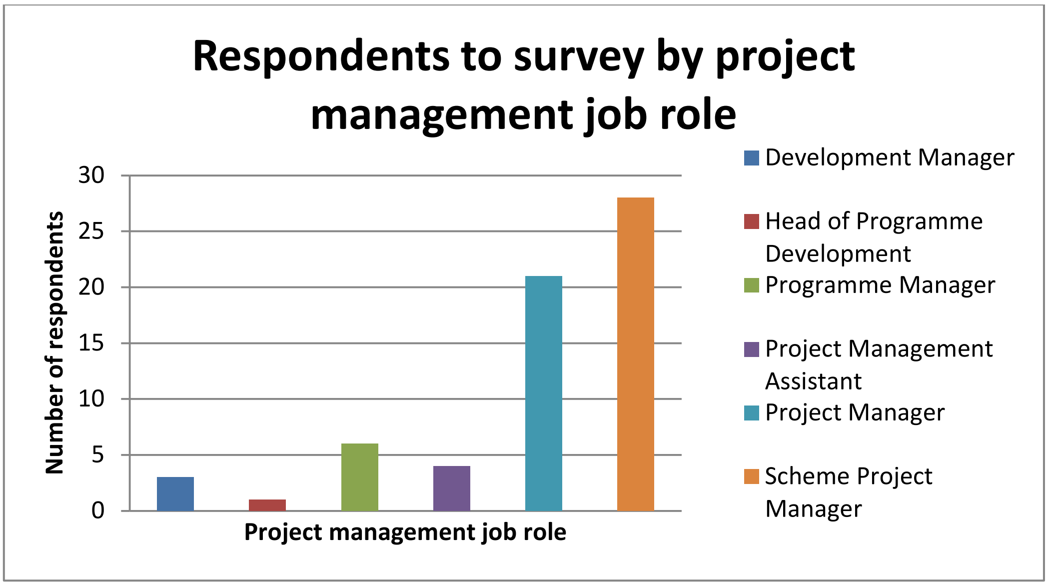
8.1 General information

The first section of the questionnaire detailed the basic project information that would be used in the maturity assessments and give context to the barriers being identified. This information also helped in supporting the conclusions of the study.

8.1.1 Online survey respondents

As set out in Fig. 8.1, sixty-three people responded to the online questionnaire, all of whom worked in infrastructure project management and represented a good cross-section of project management seniority levels.

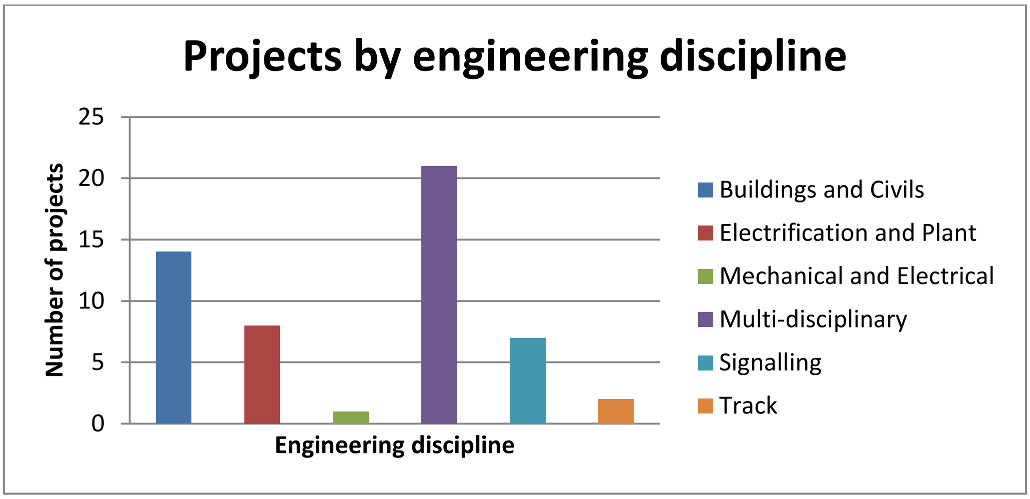
Figure 8.1 Survey respondents by project management role



8.1.2 Infrastructure engineering disciplines represented

Of the sixty-three respondents, this represented fifty-three individual projects which were spread across the various engineering disciplines within railway construction, detailed in Fig. 8.2

Infrastructure projects by engineering discipline



8.1.3 Financial value of all projects

The projects represented in the results totals £45.7bn in either past, current or anticipated spend and the spread of values detailed in Figure 8.3 and 8.4 demonstrates that:

- The majority of infrastructure schemes represented have a value of between £10 and £100m;
- Seven schemes can be considered as mega projects and account for £40.3bn of the total value;
- A future total spend of £37.1bn; and
- Crossrail 2 alone accounting for an anticipated £27bn of this future spend.

Figure 8.3 Project anticipated or final confirmed cost (£m)

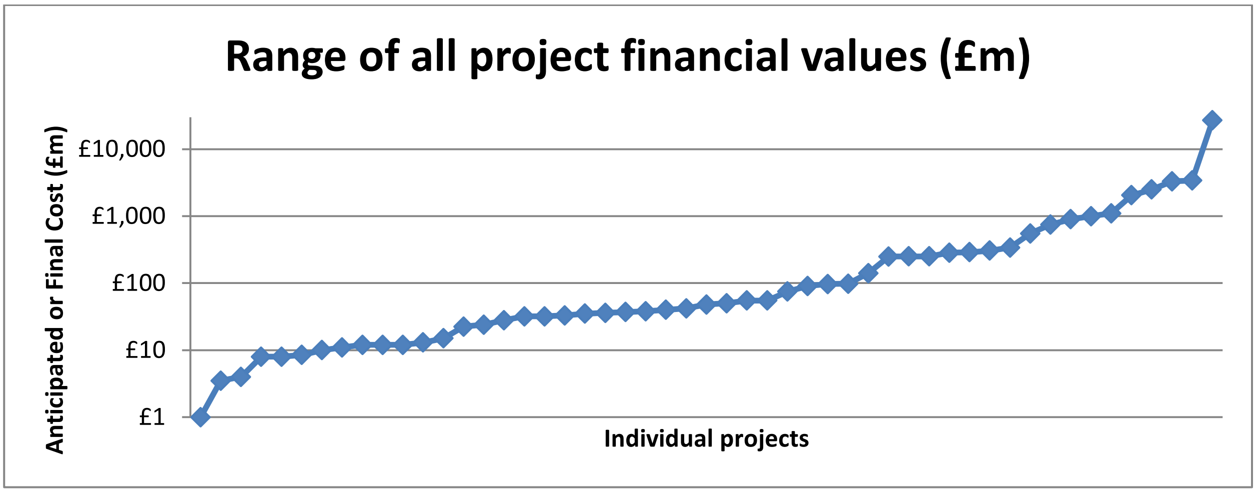
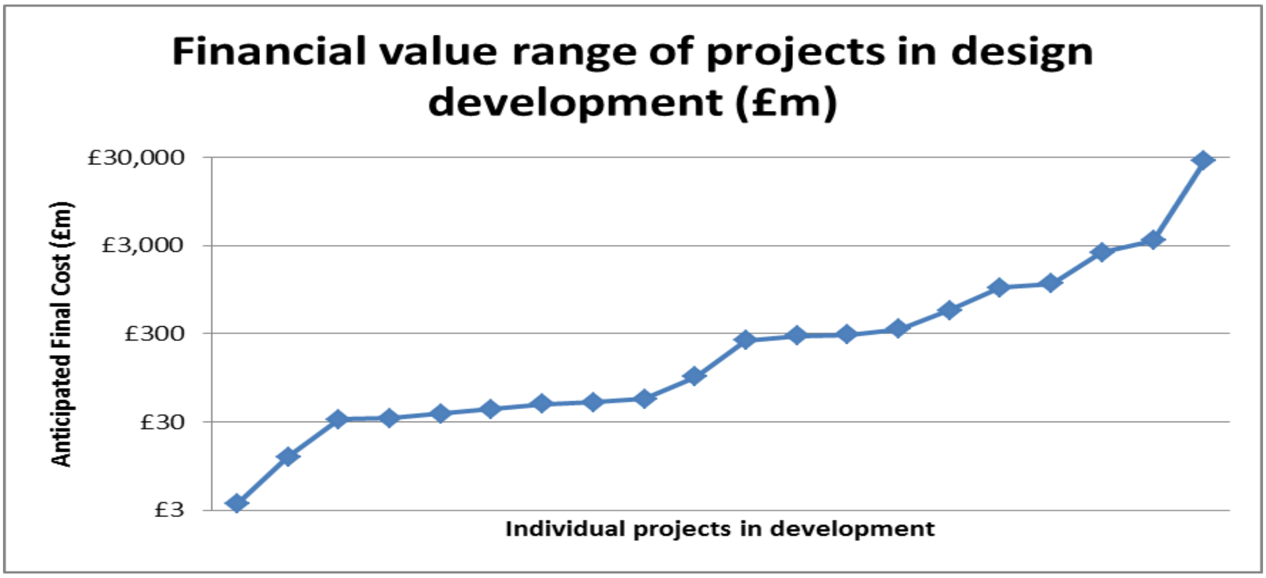


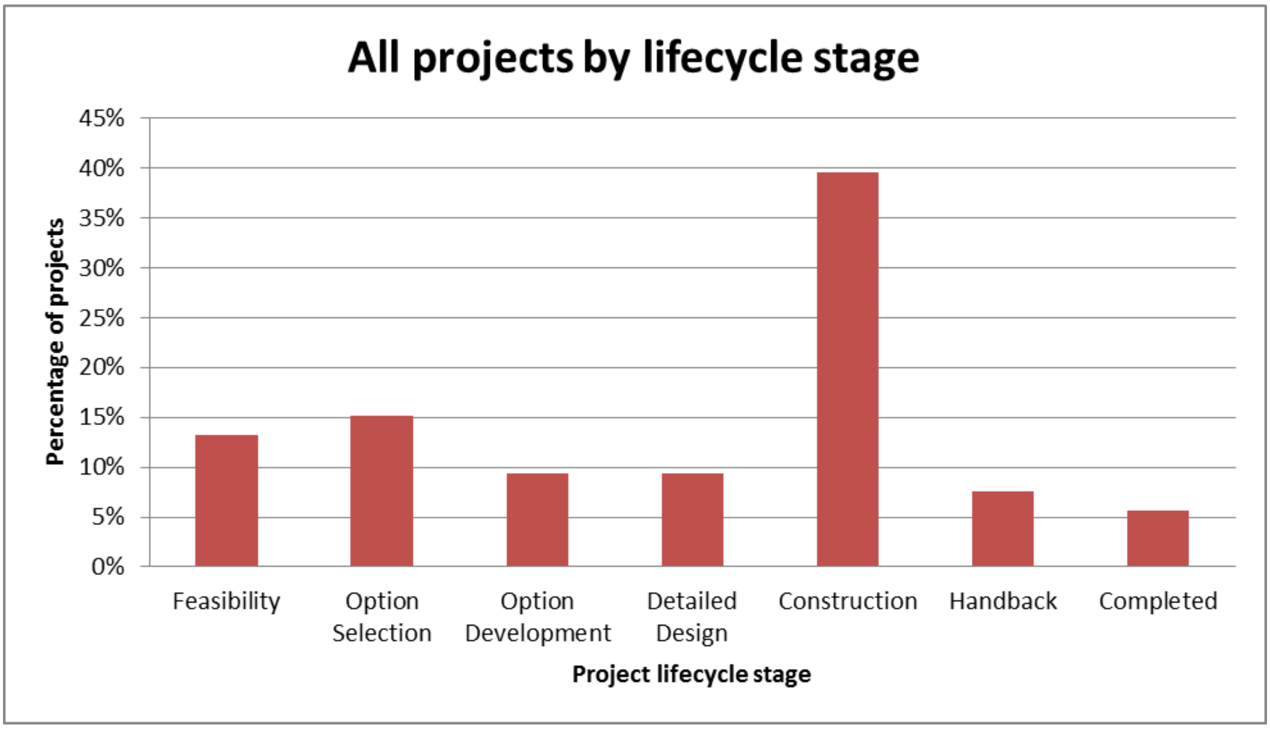
Figure 8.4 Anticipated Final Cost (£m) of projects in design development



8.1.4 Projects by lifecycle stage

Of the schemes being analysed, 40% were in the construction phase and 47% in the design phase of the project lifecycle to a greater or less degree and therefore represents a broadly even spread of project types in terms of their place in development or delivery.

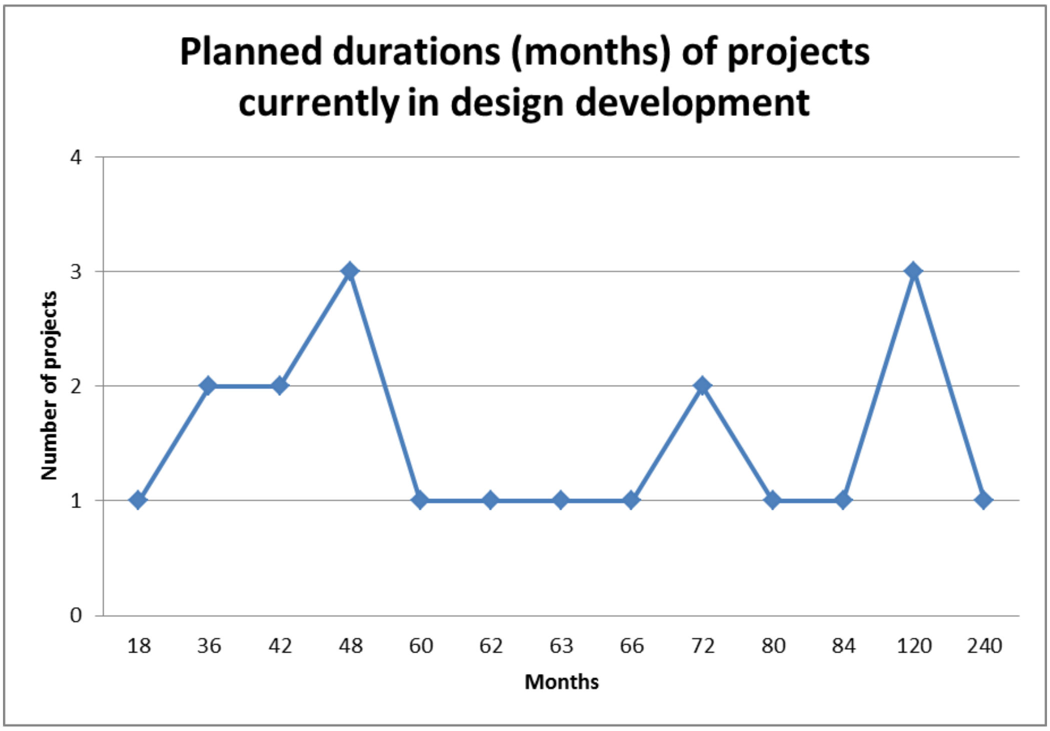
Figure 8.5 All projects by their stage in the lifecycle



8.1.5 Planned construction durations of future projects

The future construction durations varied greatly, but averaged 50 months, as set out in Fig. 8.6.

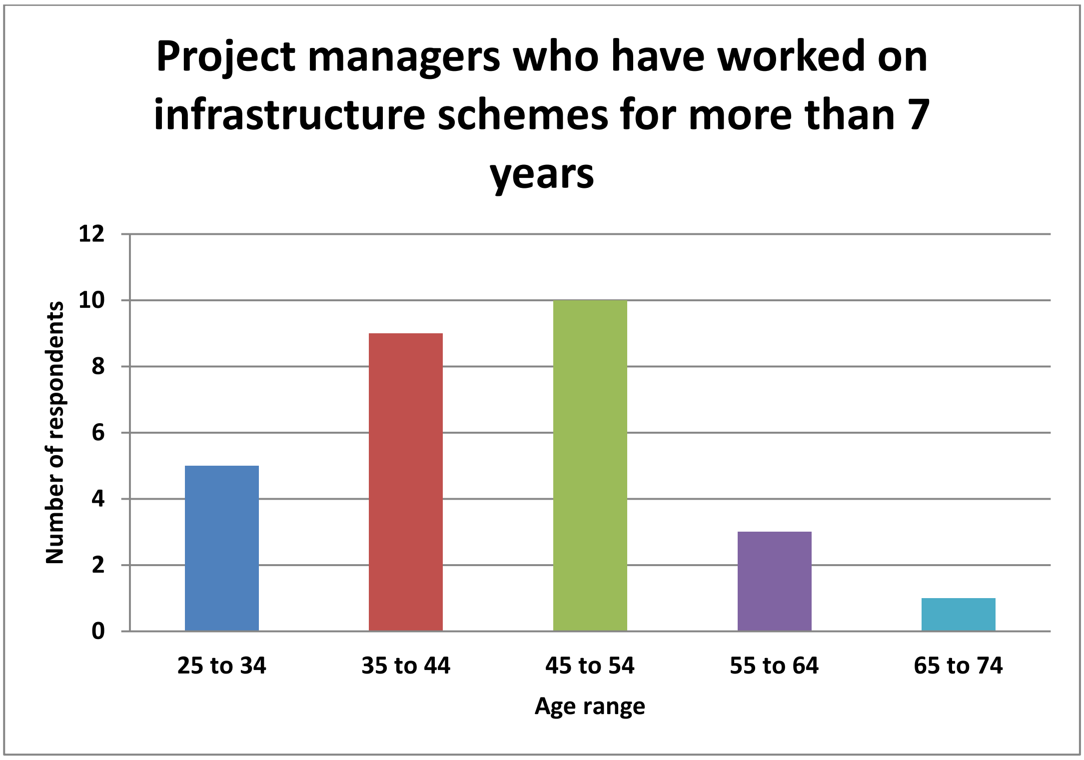
Figure 8.6 Planned durations of projects currently in design development



8.1.6 Infrastructure project manager's length of employment

From analysing the results of the questionnaire, it was discovered that project managers tend to work infrastructure project management for a substantial amount of time as detailed in Fig. 8.7

Figure 8.7 Project managers with seven or more years of infrastructure experience



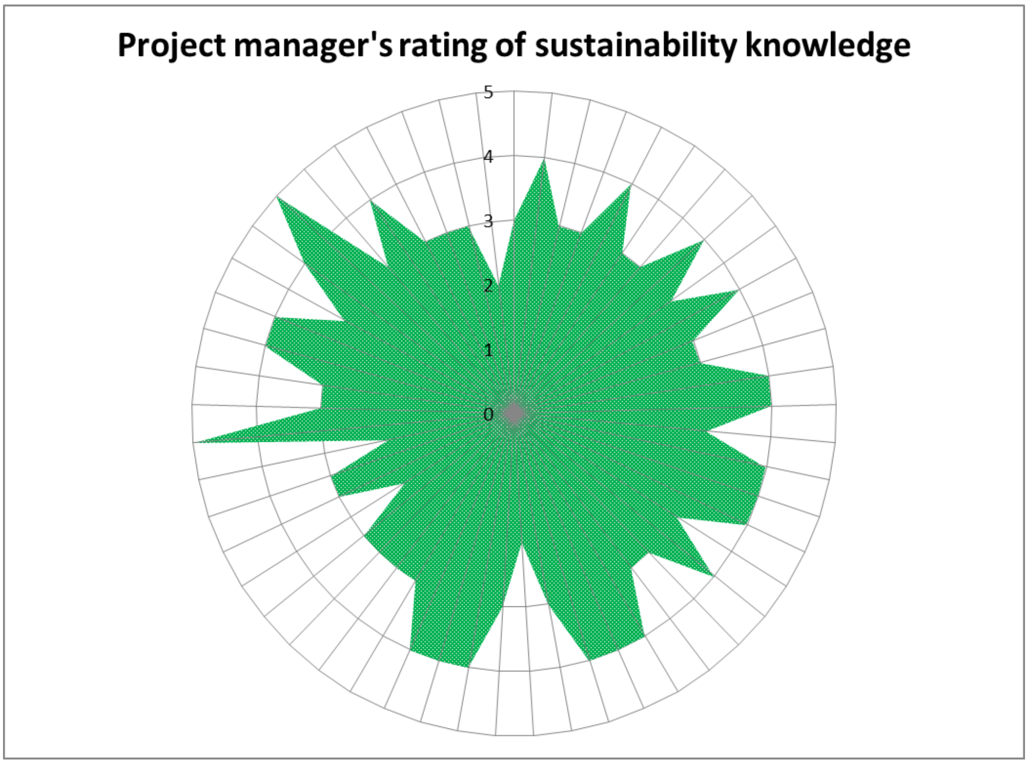
8.2 Current project sustainability maturity levels

This section of the results highlights the project manager's interpretation of the current sustainability maturity levels of the schemes they selected for this research.

8.2.1 Project managers rating of sustainability knowledge

Project managers rated their knowledge as an average of some to good

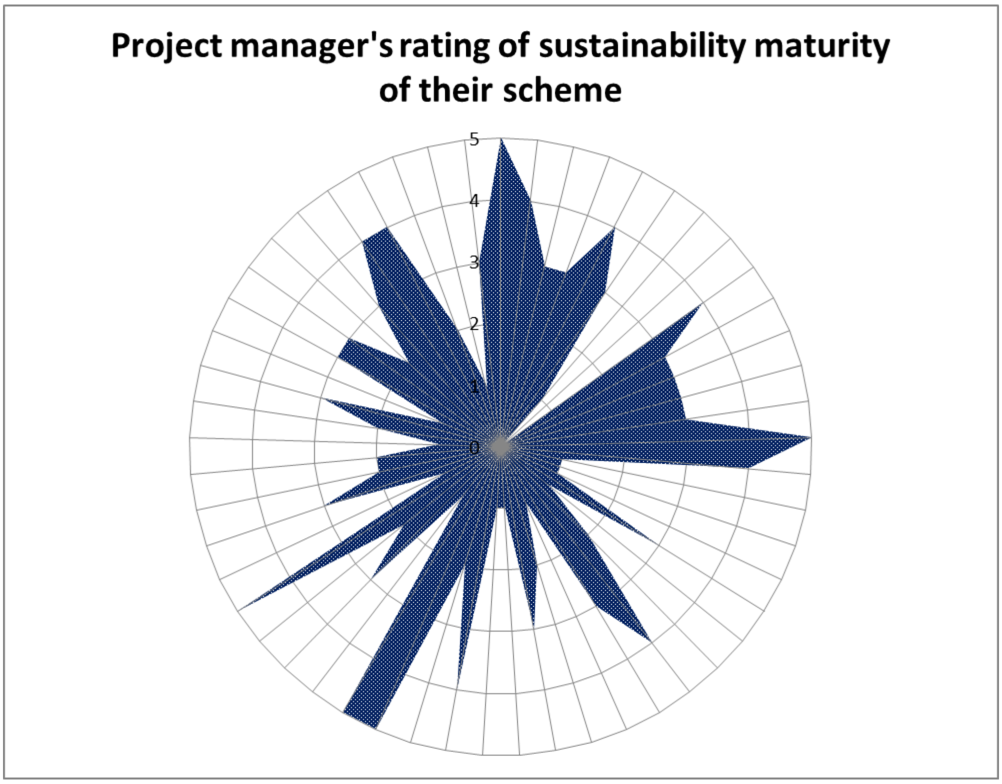
Figure 8.8 Project manager's rating of their personal sustainability knowledge



8.2.2 Project managers rating of project sustainability on their scheme

Project managers rated their scheme as 2.6 out of 5 for implementation of sustainability on their scheme.

Figure 8.9 Project managers rating of project sustainability on their scheme



8.3 Project maturity

The principle of the maturity models is to work from the top clockwise towards those schemes that are every

8.3.1 Health and safety management maturity

Figure 8.10 Health and safety management maturity levels by ascending project financial value (top, clockwise)

8.3.2 Social impact maturity levels

Figure 8.11 Social impact maturity levels by ascending project financial value (top, clockwise)

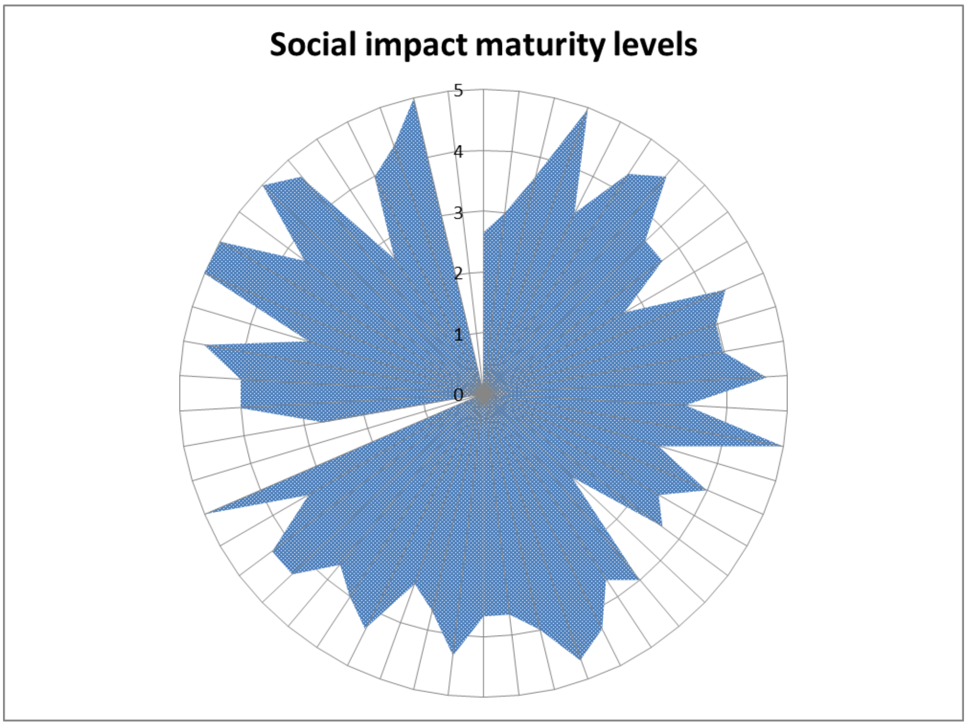


Figure 8.12 Economic impact maturity levels by ascending project financial value (top, clockwise)

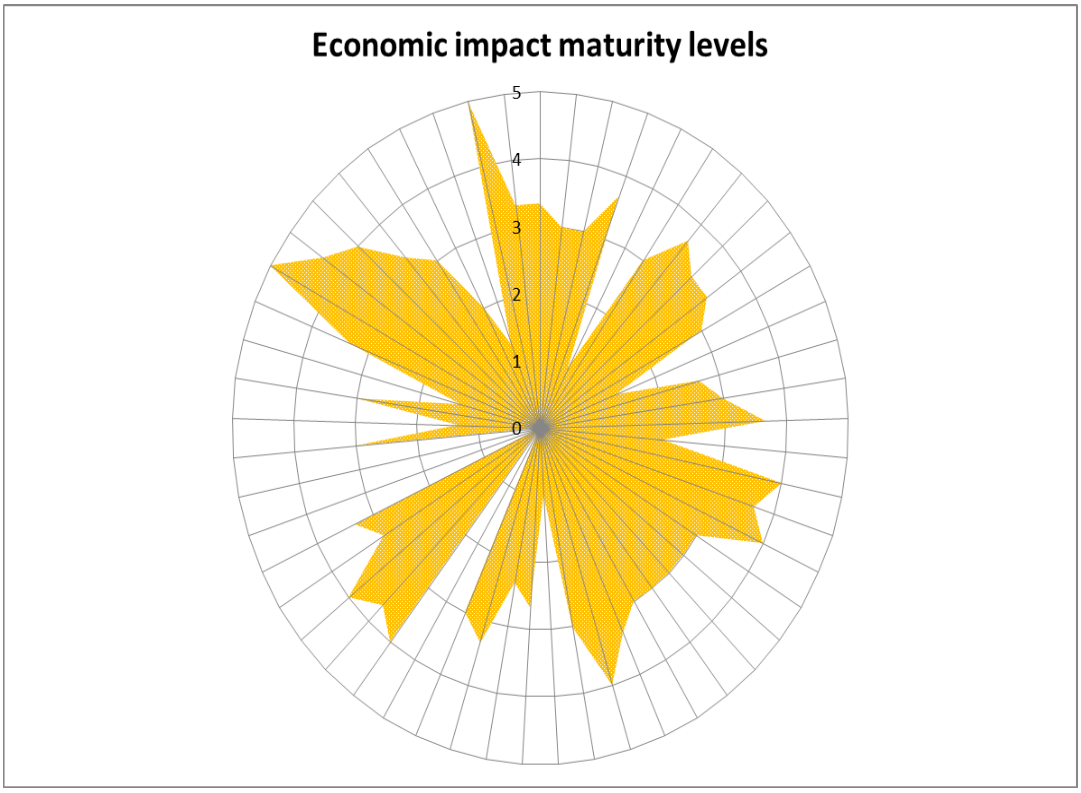


Figure 8.13 Environmental impact maturity levels by ascending project financial value (top, clockwise)

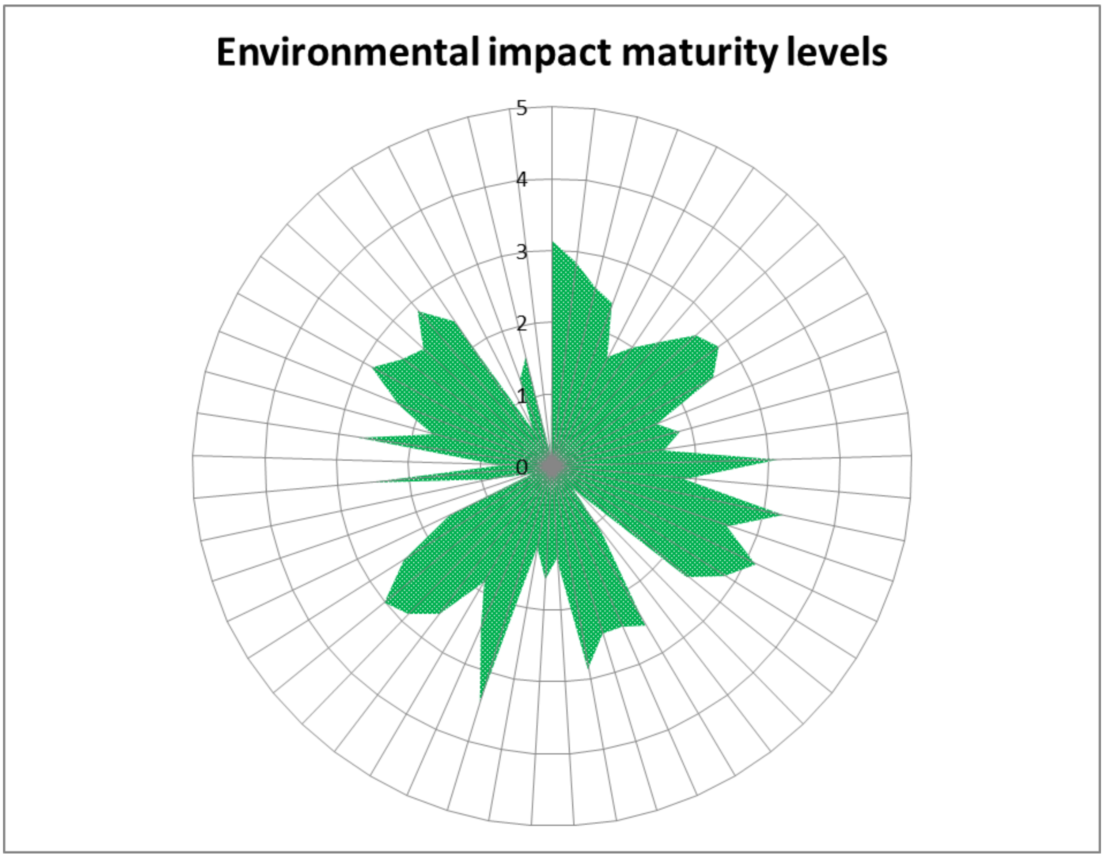


Figure 8.14 Project management maturity levels by ascending project financial value (top, clockwise)

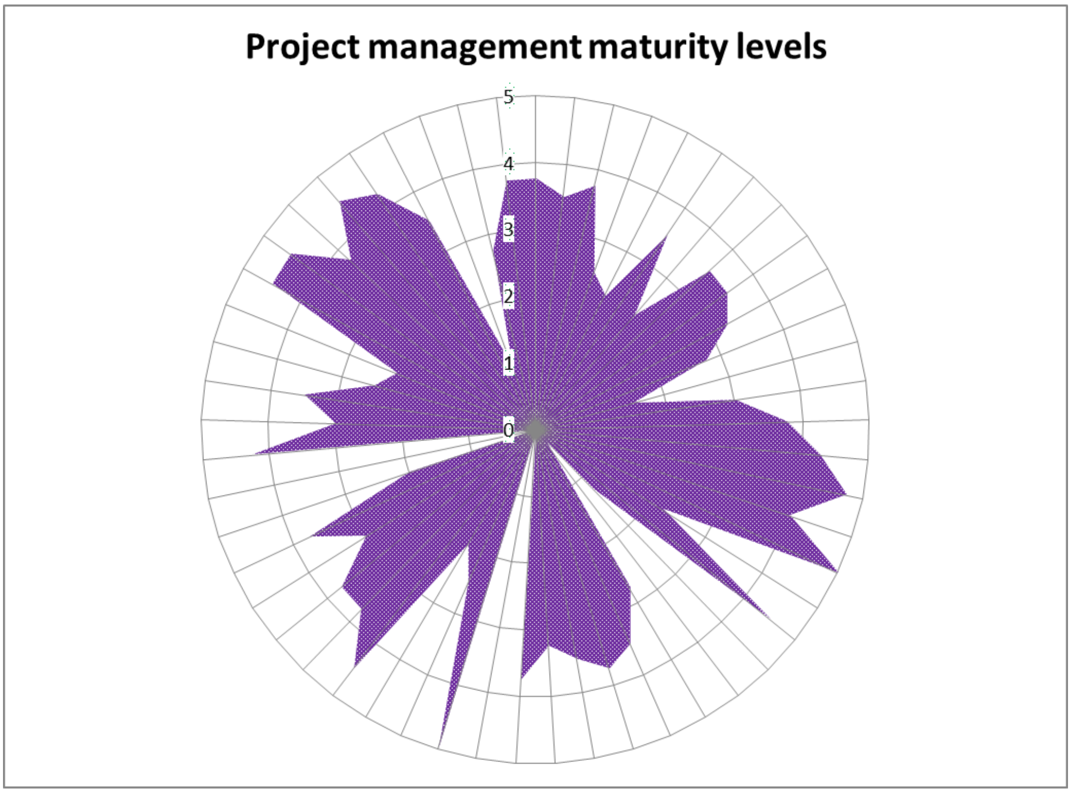
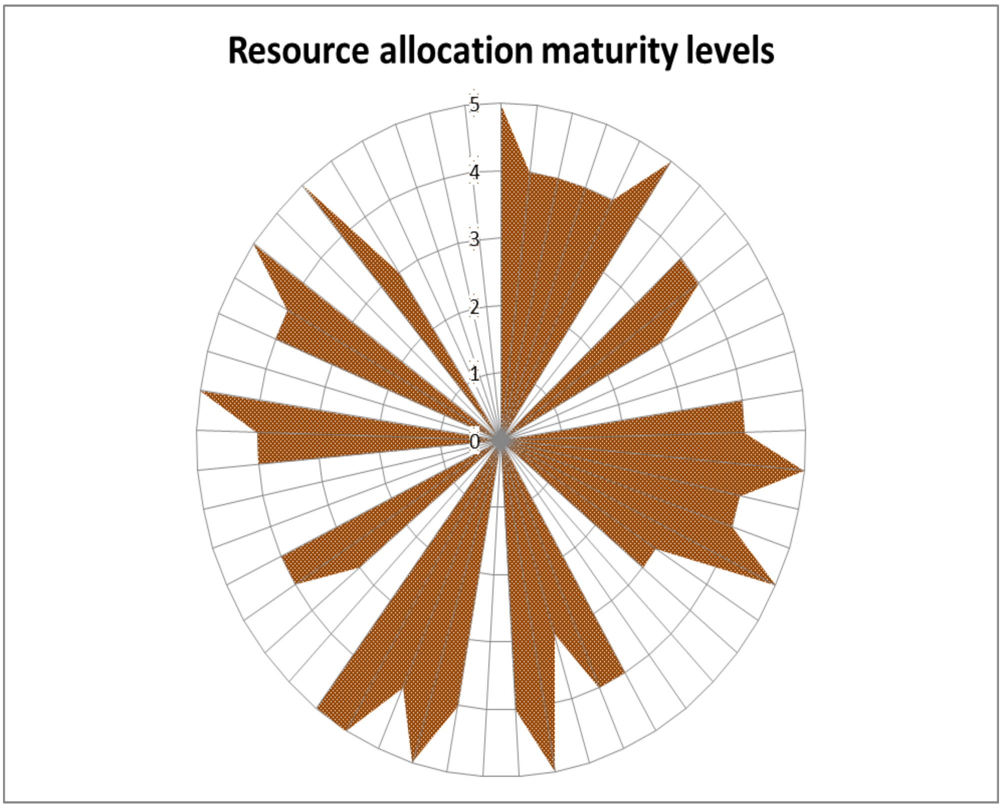


Figure 8.15 Project management maturity levels by ascending project financial value (top, clockwise)



When comparing the results from the questionnaire against the barriers Kotter identified, there were the following trends…

8.3.3 What barriers did project managers identify?

All sixty-three respondent's answers were considered in this section of the data because each of them work to a greater or lesser extent in infrastructure project management.

Table 8.1 To what extent do you have a personal sense of urgency to do something?

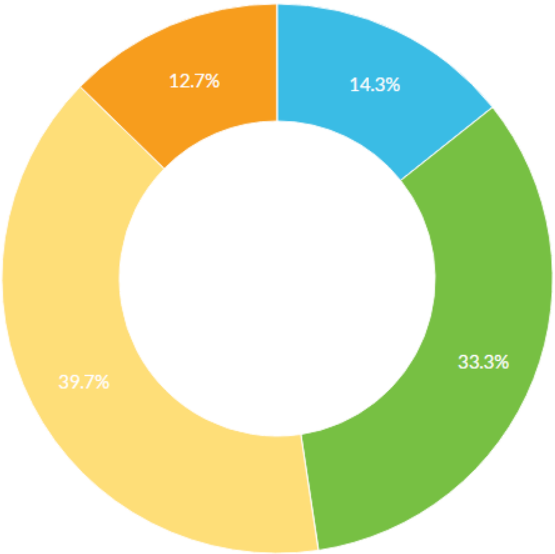
	No interest in sustainability and no sense of urgency Some interest in sustainability, but no sense of urgency Some sense of urgency, but no clear actions undertaken Clear sense of urgency and some actions undertaken Very active sense of urgency and clear set of actions undertaken

Table 8.2 To what extent do you feel part of a group of people undertaking action around sustainability?

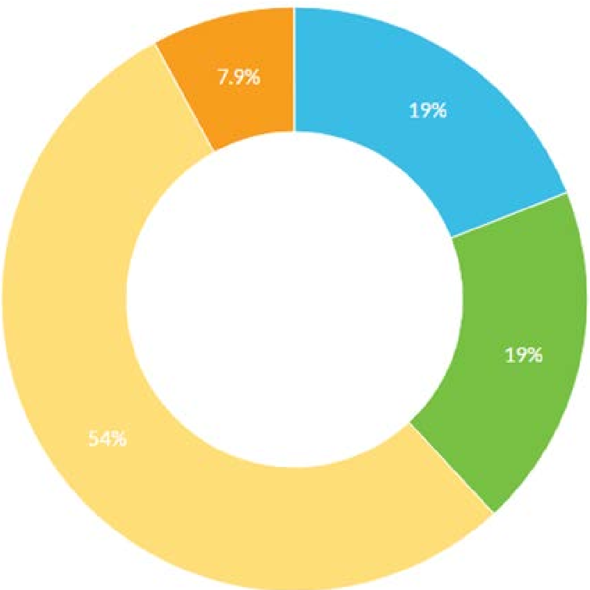
	Actively put off from taking part in sustainability initiatives No feeling of being part of any group Feel part of a group, but no initiatives taking place Feel part of a group and some initiatives taking place Feel part of a group and a significant number of initiatives taking place

Table 8.3 To what extent would you say that you understand the vision of what a sustainable infrastructure project looks like?

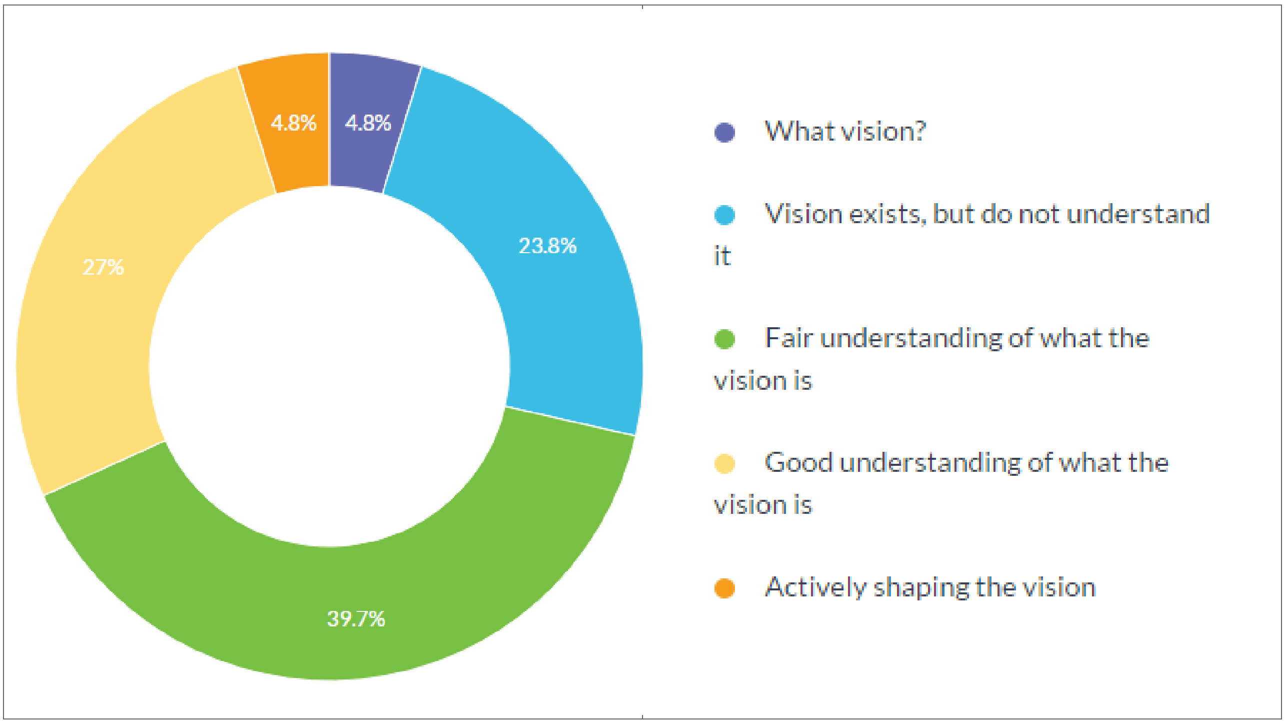


Table 8.4 To what extent do you feel that the sustainability vision for infrastructure projects has been communicated to you?

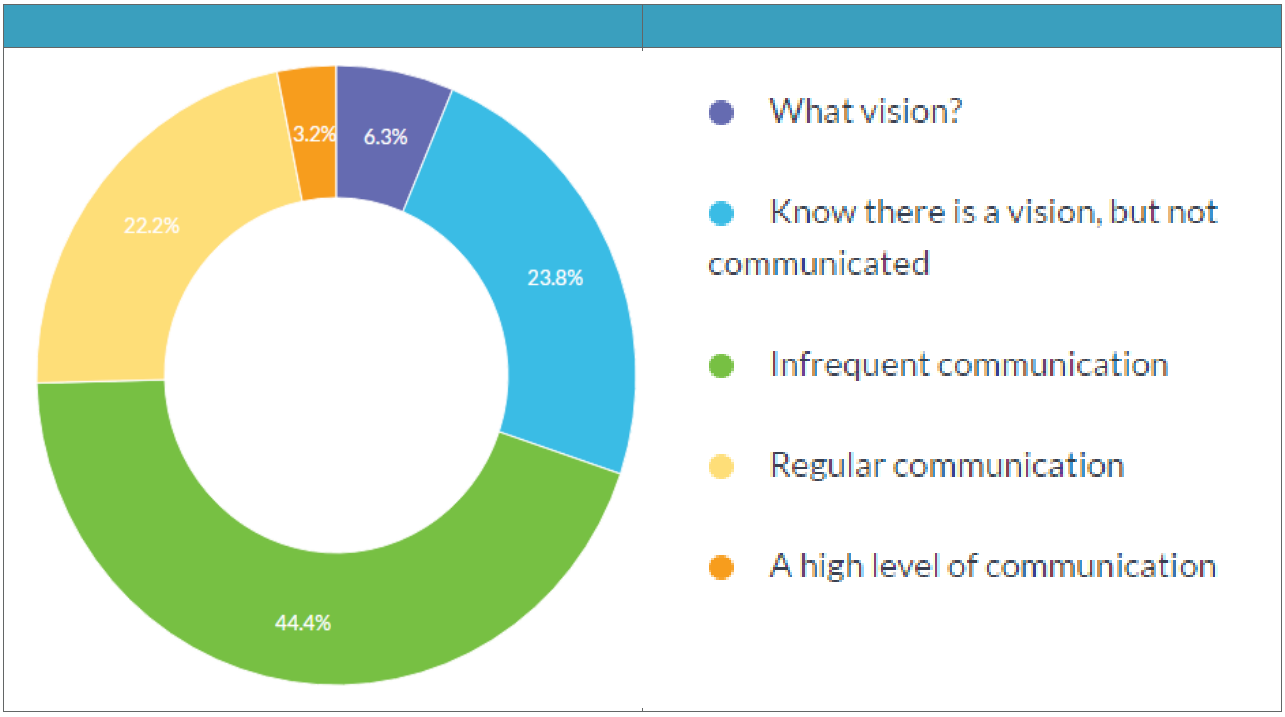


Table 8.5 To what extent do you feel that you can take the lead on achieving the infrastructure project vision of sustainability on your project?

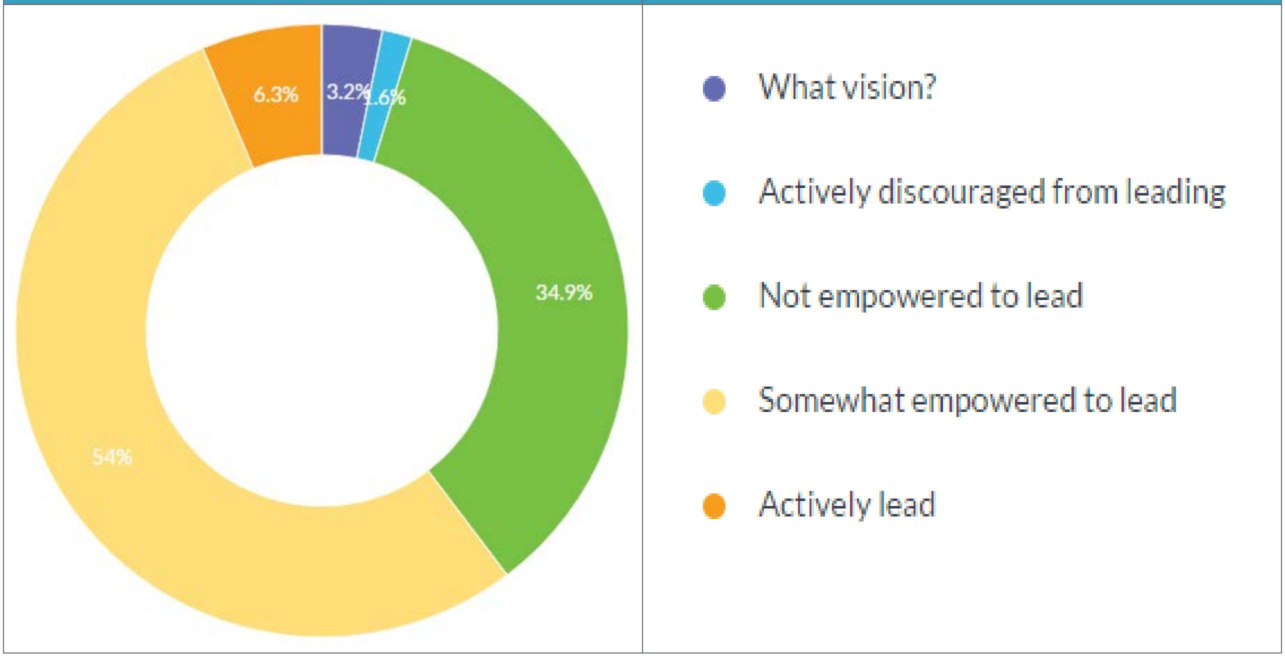


Table 8.6 What sustainability outcomes has / did your project achieve during the design and / or construction phase of the project?

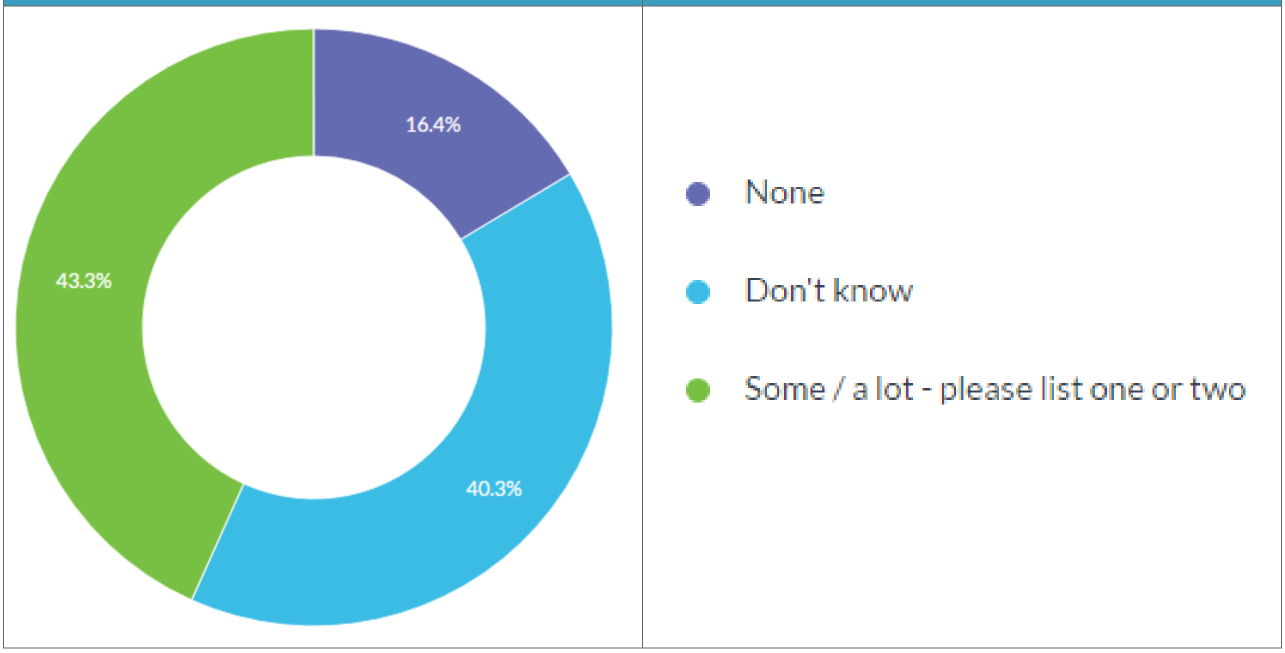


Table 8.7 What sustainability outcomes will / has your project achieved beyond the design and / or construction phase of the project?

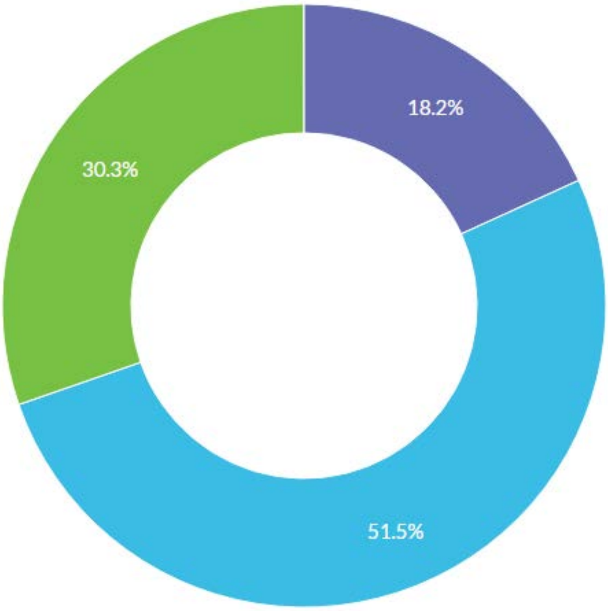
	● None ● Don't know ● Some / a lot - please list one or two

Table 8.8 To what extent is the embedding of sustainability now 'business as usual' in all of your projects?

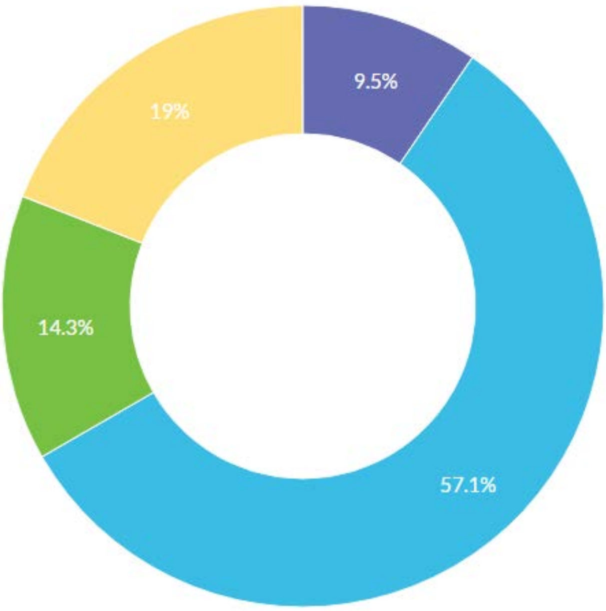
	● Embedded for all areas of sustainability ● Embedded in some areas of sustainability ● Don't know ● Not at all business as usual - please state in one or two sentences why this is the case?

Table 8.9 Kotter barriers comparison

8.4 Other barriers identified

Table 8.10 Barriers identified through the questionnaire

Priority	Type of barrier	
1	Funding / increased costs / too much focus on cost / budget constraints	
2	Expertise of those leading initiatives / lack of knowledge / people don't know what it is / don't understand what the company vision is or how to implement	
3	The drive to be efficient / culture of deliver for as little as possible /	

	lacking of focus on whole life cost / this can be the case very much on small projects	
4	Pressure of the programme / time needed to deliver / too much focus on time	
5	Lack of support to implement on projects	
6	Not enough consideration early enough in the project / lack of forward planning	
7	Lack of understanding between the different infrastructure elements	
8	Not a top priority	
9	Supply of products	
10	Third party constraints on funding	
11	People cannot be bothered as there are other more important things to do	
12	Lack of senior management buy-in / business culture / optional extra, not business as usual	
13	Lack of training	
14	Not specified in scope	

8.5 How to overcome the barriers

Table 8.11 How to overcome the barriers

	Provide separate sustainability resource to support projects	

8.6 What measures are needed to put them in place

Table 8.12 Measures that could measure progress and benefits

8.7 Findings from the interviews

8.7.1 Sir Robert McAlpine

[add in notes from meeting]

8.7.2 Environment Agency

Use the case study sent through from Andrea.

8.7.3 Crossrail 2 Case Study

[Insert env policy]

8.7.4 RSSB Sustainability Lead

A discussion was held with the sustainability lead for the RSSB to compare my findings with a similar survey they had conducted across the wider rail industry. [expand]

8.8 Findings from the workshops

A summary of the current maturity of projects and the barriers identified were presented to the participants. The workshop was undertaken in three parts around discussions of the questionnaire results, more in depth identification of how to overcome barriers and discussing measures that would need to be put in place to demonstrate progress.

8.8.1 Access to infrastructure

Some of the workshop participants felt that the project managers completing the survey may not have always fully understood what was meant by the questions and may have had different interpretations of what it mean to access the infrastructure in railway context i.e. passengers or freight?

8.8.2 Employment opportunities

- Projects need to develop mechanisms to develop local employment. However, they need to be mindful that many people come from across the country to work on different sites e.g. site operatives will travel from northern England to work on sites in the south before returning home.
- It was noted that London Underground have had a rule that stipulates that operatives need to be able to work 20 minutes from site.
- When developing contract frameworks there need to be mechanisms developed that stipulate the requirements of local employment opportunities that are mindful of skills requirements.
- Projects need to be able to source the right skilled individuals and therefore the concept of local employment is not always possible. Where there are skills shortages, these need to be made up from out of area. There needs to be information made available that determines what the skills gaps are in an area.
- Project should potentially act as a catalyst for upskilling local people.
- Projects need to consider how they can transfer the newly skilled people to ensure that their efforts in developing knowledge are not wasted.

8.8.3 Cost v value

- The challenge is moving towards a value measurement as opposed to purely cost driven which is how projects are currently measured. [links to the concept of natural capital?]
- There needs to be a much greater focus on whole life cost and sustainability should not be seen as something separate.
- There needs to be a greater use of whole life costing as opposed to just thinking about the upfront capital costs.
- Local income –smaller projects should consider how they affect local trades in the widest sense e.g. places to eat, welfare provision etc. To improve an understanding of the effect on local

income, projects need to better understand the business case. If the project manager understands the business case, then they can better help the sponsor.

9. Conclusions

9.1.1 There is a major opportunity

- £xxbn of future planned spend
- Increasing profile of agenda

9.1.2 Absence of direct government drive means that clients need to take a lead

Current UK government investment criteria makes no direct reference to being sustainable and therefore in the absence of a change of policy, it is down to clients to drive the terms of sustainability with reference to other areas of policy.

9.1.3 Use of client power

According to a 2016 Accenture report, 89% of CEOs say that a commitment to sustainable development is having a real impact in their industry and 86% of CEOs believed that standardised metrics will be important in unlocking the potential of the sustainable development goals and are still looking at how they can develop metrics that translate into business success. However, only 10% believe that they are being driven by investors (Accenture, 2016). Client organisations need to make better use of the future investment to unlock this potential. Use of procurement frameworks to influence how employment etc. is carried out (client power).

9.1.4 Project management culture

Ensure that projects think of themselves as being beyond the immediate construction area and engage with other agencies that have knowledge.

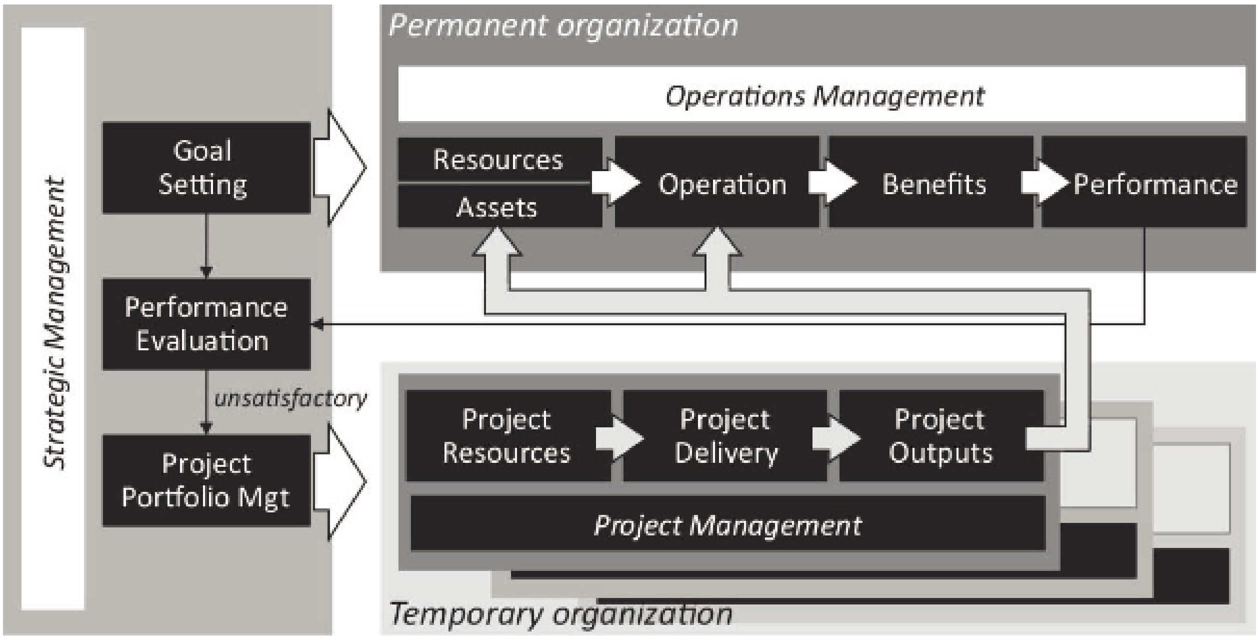
9.1.5 Processes

Sustainability needs to be an underlying issue and not seen as something separate to be undertaken.

9.1.6 Funding – focus on whole life cost

It is vital that projects look towards a whole life perspective to show the long term benefits of taking measures today to incorporate long term sustainability.

Figure 9.1 Sustainability integrated into the whole project lifecycle (Dalcher et al, 2012)



9.1.7 Making sustainability simple

There needs to be clear guidance and language used that everyone can adopt on projects.

9.1.8 Thinking small – it's not all about money

In the English regions, there are more projects since smaller localised projects are easier to plan, and they are generally cheaper because of their smaller scale. (IPA, 2016). For example, in the South East, there are 76 projects in the Pipeline, costing a total of £12 billion, compared to the 5 projects in England, Scotland and Wales, that cost £28 billion.

9.1.9 Sustainability specific conclusions

Access to infrastructure – projects need to be very clear about what the customer is for their project

10. Recommendations to industry

Project management needs to evolve from ‘doing things right’ to ‘doing the right things right’ (McKinlay, 2008) because there is clear evidence that business as usual is not an option because of the profound changes underway.

10.1.1 Small scale changes

Focus on what can be done to support the project managers of small scale schemes. Whilst these do not attract the funding levels of the major schemes, they have a greater total footprint and can really drive sustainability in their areas.

10.1.2 Funding issues – there is a large amount that requires client leadership

Need to make more efficient use of the funding that already exists through procurement and contractual processes; it’s not necessarily about more.

Where there are additional funding requirements, there needs to be a clear understanding of the benefits that will accrue to the project through the additional investment and gain a wider understanding of project success.

10.1.3 Expertise

There needs to be more support from experts that support project managers in the vision and implementation. It’s important that they understand support the project in a practical way and that the language is clear. It’s important that project managers are bought into the wider concept of sustainability and not just the environment.

10.1.4 Tools

There needs to be practical and easy to support tools that are accessible for project managers

10.1.5 Better planning

There was a discussion around the drive to be efficient and deliver, but the delivery of a project is not delayed by this and is a red herring argument, which shows that there needs to be better planning to ensure that it is built in and part of delivery so that the iron triangle of time, cost and quality is not compromised.

10.1.6 Project manager needs to break silos

The project manager should ensure that all disciplines are bought into the vision.

10.1.7 Governance

Using governance as a mechanism to ensure there are changed behaviours and that projects are held to account for their planning and delivery of sustainability.

10.1.8 Senior leadership

There needs to be a cultural push in the same manner as improving safety so that project managers cannot be allowed to not be bothered.

10.1.9 Metrics – avoiding the tragedy of the commons

There needs to be development of metrics that can support the buy-in from seniors and ways to demonstrate the benefits to a scheme in its wider context. In this way, it will be potentially possible for projects to demonstrate their direct effect and not allow sustainability to remain something so vague and diffuse, that no one takes ownership.

10.1.10 Training

The evidence from the survey pointed that project managers tend to stay within infrastructure for long periods of time and therefore investment in training will reap a payback in terms of improving sustainability.

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12. Appendices

12.1 Appendix A – Survey Questions

Question	Why was this asked?
What is your full name?	In order to identify an individual for a follow-up discussion
What is your job title	To ensure that only those managing projects were included within the scope of this research
What is your job title?	
Are you directly employed by Network Rail?	
Are you currently based in the Network Rail Infrastructure Projects function?	
How many years have you worked in infrastructure project management, either as part of Network Rail or another company?	
Please state the title of the project you have selected for consideration in this questionnaire	
What GRIP stage is the project currently at?	
Please describe the aim of the project in one sentence	
In which area(s) of the UK is / was the project located?	
What is / was the principle engineering discipline(s) of the project?	
What is / was the anticipated / actual final cost of your selected project?	
How is / was the project funded?	
What is / was the anticipated / actual duration of the project (in years and months)?	
How knowledgeable would you consider yourself to be about the concept of sustainability?	
The next set of questions ask you to consider	

the extent to which different elements of sustainability are integrated into your selected project. Before answering, how would you rate the project you...	
To what extent does / did the project ensure that the health and safety of employees and the wider public is effectively managed during design and construction?	
To what extent does / did the project increase access to railway travel for people in the local area?	
To what extent does / did the project increase the general well-being of people in the local area?	
To what extent does / did the project engage with local stakeholders to understand their needs, knowledge and requirements?	
To what extent does / did the project increase employment opportunities in the local area?	
To what extent does / did the project increase income levels in the local area?	
To what extent does / did the project increase the number of businesses being established in the local area?	
To what extent does / did your project increase biodiversity in the local area?	
What impact does / did noise have on the local area during construction?	
To what extent does / did the project minimise pollution in the local area during the construction of the infrastructure?	
To what extent is / was the project carbon neutral during construction of the infrastructure?	
To what extent does / did the project build climate change resilience into the existing and / or new infrastructure?	

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To what extent does / did the project enhance the existing local landscape?	
The what extent is / was the project a net importer of waste during construction?	
To what extent does / did the project incorporate innovation into the design and construction?	
To what extent does / did the project make use of integrated information systems throughout the design and construction phases?	
To what extent does / did the project adopt whole systems thinking throughout design and construction?	
To what extent does / did the project ensure that allocated resources (land, labour, materials, plant, water etc) are / were utilised efficiently during design and construction?	
To what extent does / did the project ensure that sustainability principles are / were incorporated into the procurement of goods and services during design and construction?	
What elements of sustainability do / did you incorporate into your project during design and / or construction that have not been listed?	
The next set of questions seek to understand your views around some common barriers that can hinder integrating sustainability into projects. Before proceeding, please rate the extent to which you believe that you face / faced barriers on your project. 0 = No barriers at all 5 = Barriers encountered across all elements of sustainability.	
To what extent do you have a personal sense of urgency to do something?	
To what extent do you feel part of a group of people undertaking action around sustainability?	
To what extent would you say that you	

understand the vision of what a sustainable infrastructure project looks like?	
To what extent do you feel that the sustainability vision for infrastructure projects has been communicated to you?	
To what extent do you feel that you can take the lead on achieving the infrastructure project vision of sustainability on your project?	
What sustainability outcomes has / did your project achieve during the design and / or construction phase of the project?	
What sustainability outcomes will / has your project achieved beyond the design and / or construction phase of the project?	
To what extent is the embedding of sustainability now 'business as usual' in all of your projects?	
What other barriers do you feel hinder the integration of sustainability into your projects?	
What tool(s) and / or support would help you to start or increase the embedding of sustainability into your projects? Your answer to this question is very valuable in helping to develop recommendations about how to overcome the barriers identified	
What performance measure(s) do you think need developing / further development in order to effectively monitor sustainability initiatives in projects? Your ideas here will be very valuable for making recommendations in this study	
Would you be willing to take part in one follow-up workshop during November or December 2016 that will further explore some tools required to support embedding sustainability and key metrics for measuring progress? A workshop would be a maximum of 2-2.5 hours and I would aim to have it as close to your workplace as is practical	
Would you be happy for me to potentially use your project as a case study within my study? I would liaise with you around any issues that you would wish to keep confidential	

Are there any further comments you feel would be useful for my study?	
Would you like to be entered into a draw to win one of three prizes for taking part in this study? Winners will be announced after the questionnaire has closed. 1st place (£40 of Amazon vouchers) 2nd place (£20 of Amazon vouchers) 3rd place (£10 Amazon voucher)?	


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