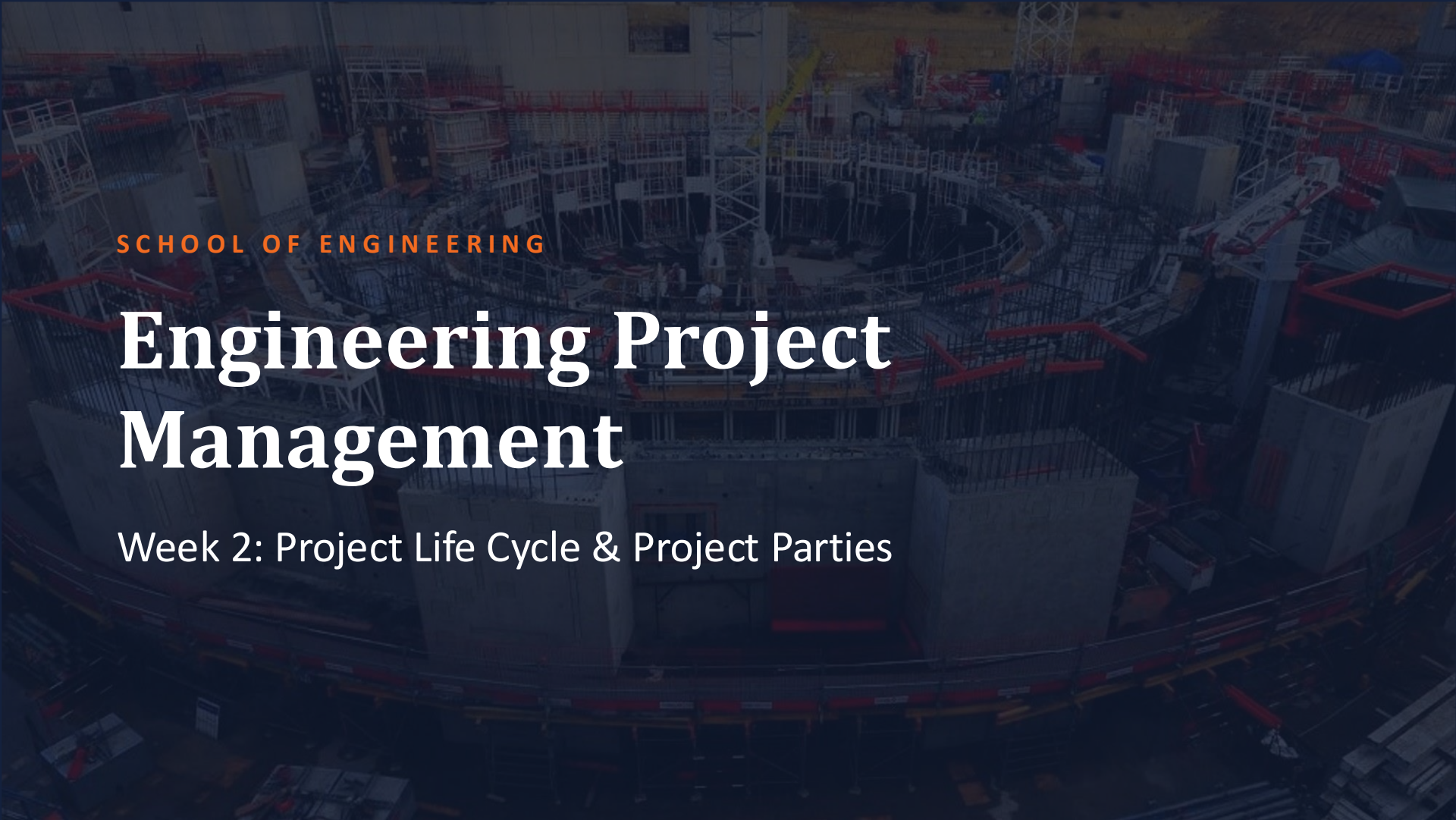


SCHOOL OF ENGINEERING

Engineering Project Management

Week 2: Project Life Cycle & Project Parties

RECAP

What is a project?

1. Has a clear objective
2. Has constraints on Cost, Quality and Time
3. Has a team of people
4. Has little practice or rehearsal
5. Is punctuated with change & uncertainty
6. Is unique

AND HAS A DEFINABLE

Start

when work is approved

End

when objectives are completed

TODAY

Two things to cover

01

The Project Life Cycle

The elements that make up a project, in more detail

02

The Project Parties

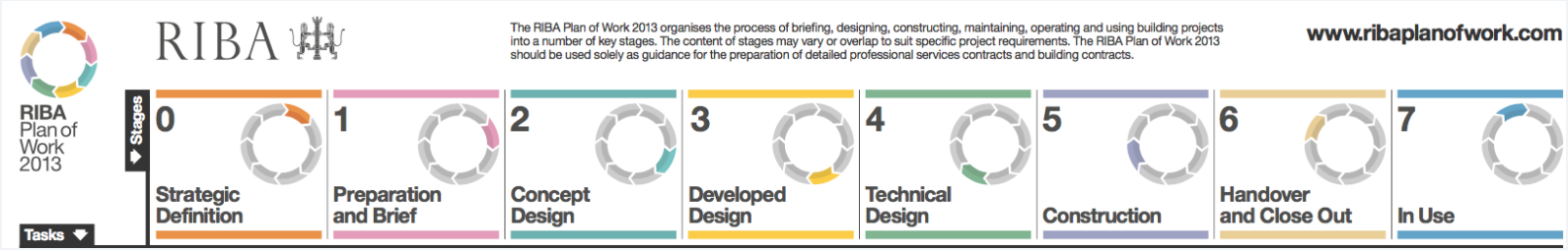
Who the key players are in all engineering projects

Ten stages from need to legacy

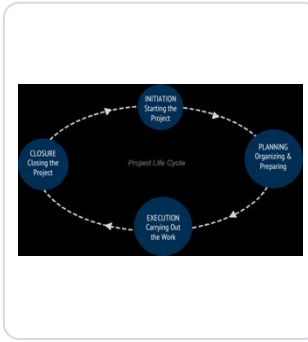


We look at these stages for LARGE projects. Small projects are just the same, only smaller. If we understand the issues for large projects, we can scale downwards.

This is not the only model













Every project starts with a need

01
Demand

A project always has a start and end point. It starts with a demand or need for a product or ‘solution’ to overcome a particular problem.

02
Initial Proposal

The project owner recognises this need and makes an initial proposal.

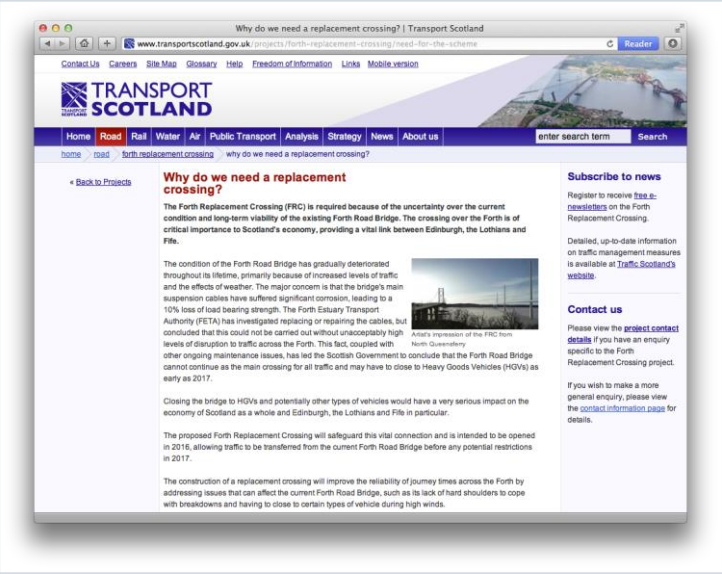
These are the first two stages in the project life cycle.

CASE STUDY 1 · PROJECT DEMAND

The Forth Replacement Crossing

Why did Scotland need a new bridge across the Forth?

Why do we need a replacement crossing?



Transport Scotland



BBC News: “Bridge replacement wins backing”

Barry Colford, FRB “Bridgemaster”

Clips from “Fifty Years Across the Forth” (BBC)



Clip 1

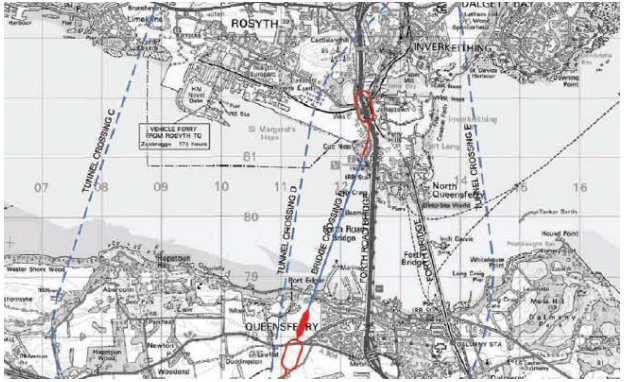


Clip 2

The Forth crossings and the route







Early concept visuals



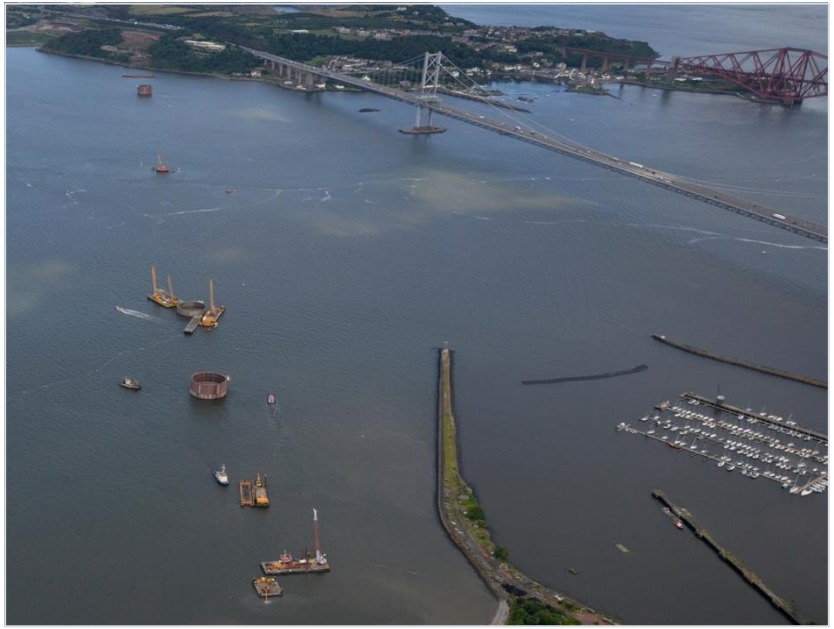


Visualising the new bridge





The bridge under construction



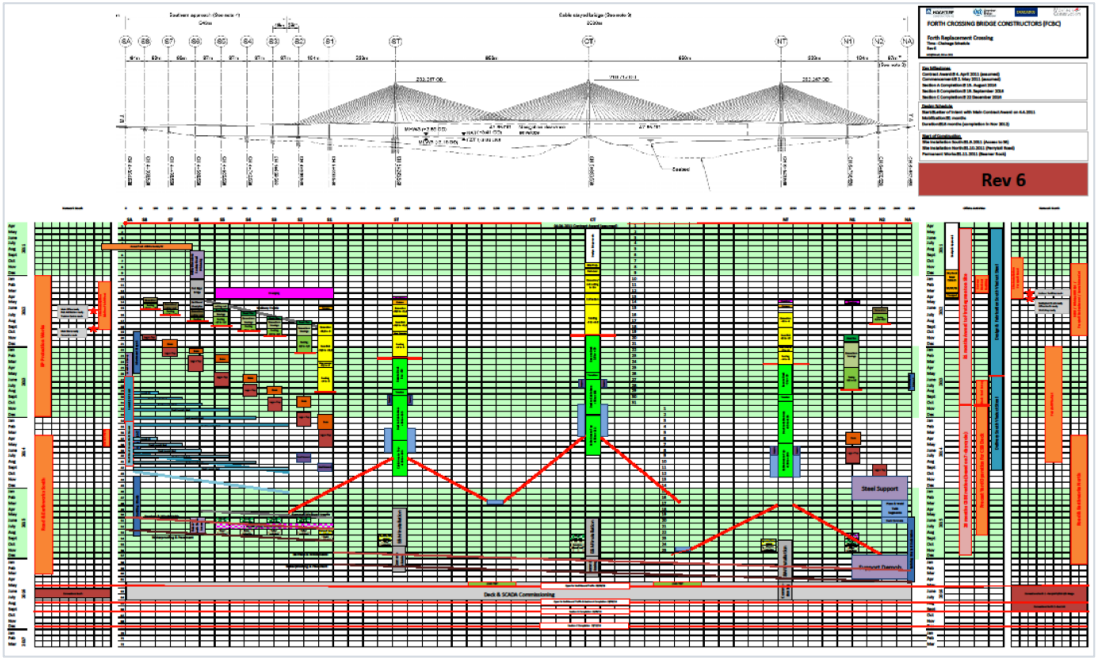


Foundations and site works





Planning the programme



Progress 2013-15









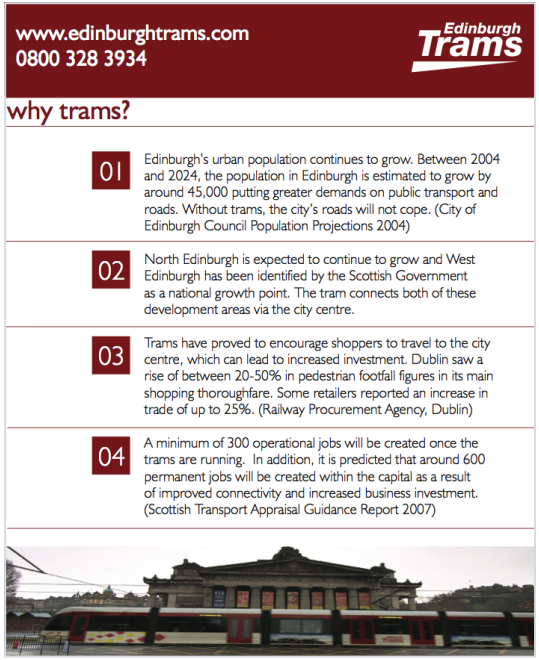
Seen from space, and from the deck





Photo credit: Tim Peake

Edinburgh Trams: making the case



www.edinburghtrams.com
0800 328 3934

Edinburgh Trams

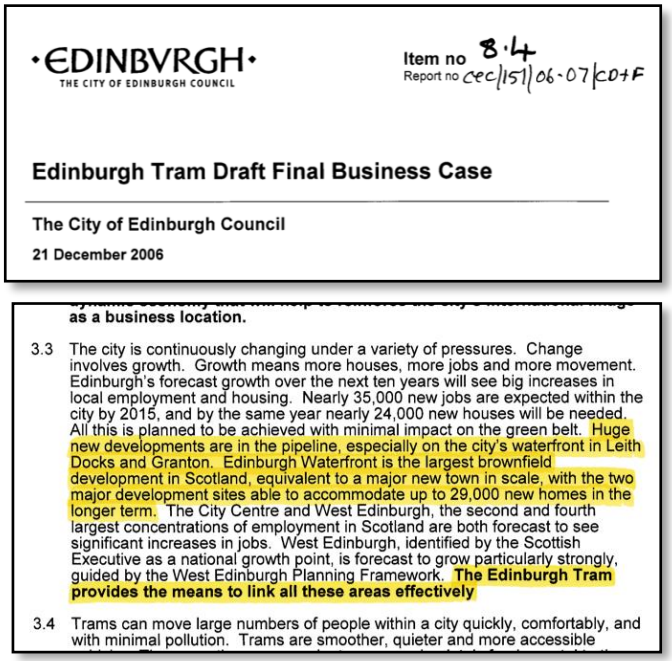
why trams?

01 Edinburgh's urban population continues to grow. Between 2004 and 2024, the population in Edinburgh is estimated to grow by around 45,000 putting greater demands on public transport and roads. Without trams, the city's roads will not cope. (City of Edinburgh Council Population Projections 2004)

02 North Edinburgh is expected to continue to grow and West Edinburgh has been identified by the Scottish Government as a national growth point. The tram connects both of these development areas via the city centre.

03 Trams have proved to encourage shoppers to travel to the city centre, which can lead to increased investment. Dublin saw a rise of between 20-50% in pedestrian footfall figures in its main shopping thoroughfare. Some retailers reported an increase in trade of up to 25%. (Railway Procurement Agency, Dublin)

04 A minimum of 300 operational jobs will be created once the trams are running. In addition, it is predicted that around 600 permanent jobs will be created within the capital as a result of improved connectivity and increased business investment. (Scottish Transport Appraisal Guidance Report 2007)



·EDINBVRGH·
THE CITY OF EDINBURGH COUNCIL

Item no 8.4
Report no CEC/151/06-07/CDTF

Edinburgh Tram Draft Final Business Case

The City of Edinburgh Council

21 December 2006

as a business location.

3.3 The city is continuously changing under a variety of pressures. Change involves growth. Growth means more houses, more jobs and more movement. Edinburgh's forecast growth over the next ten years will see big increases in local employment and housing. Nearly 35,000 new jobs are expected within the city by 2015, and by the same year nearly 24,000 new houses will be needed. All this is planned to be achieved with minimal impact on the green belt. Huge new developments are in the pipeline, especially on the city's waterfront in Leith Docks and Granton. Edinburgh Waterfront is the largest brownfield development in Scotland, equivalent to a major new town in scale, with the two major development sites able to accommodate up to 29,000 new homes in the longer term. The City Centre and West Edinburgh, the second and fourth largest concentrations of employment in Scotland are both forecast to see significant increases in jobs. West Edinburgh, identified by the Scottish Executive as a national growth point, is forecast to grow particularly strongly, guided by the West Edinburgh Planning Framework. **The Edinburgh Tram provides the means to link all these areas effectively**

3.4 Trams can move large numbers of people within a city quickly, comfortably, and with minimal pollution. Trams are smoother, quieter and more accessible

Promotional leaflet and Draft Final Business Case

Edinburgh Trams: on the street





The Project Brief

The initial proposal is formalised into a Project Brief. Its purposes are straightforward:

1

State the client's aims

The objectives, aims and priorities of the client in terms of their proposal.

2

Identify resources

How resources are to be deployed. This may include appointing various consultants.

3

Budget & programme

Key dates for initial investigations and design studies, plus cost targets for those tasks.

Once the brief is drawn up and approved, the feasibility of the proposed project can be investigated.

A feasibility study gives one answer

One purpose: to provide a specific conclusion.

Go ahead with the project

or

Abandon it

The report details the exact reasons for the decision.

A scheme may be unviable for simple reasons that can be overcome through time or other processes.

What a feasibility study covers

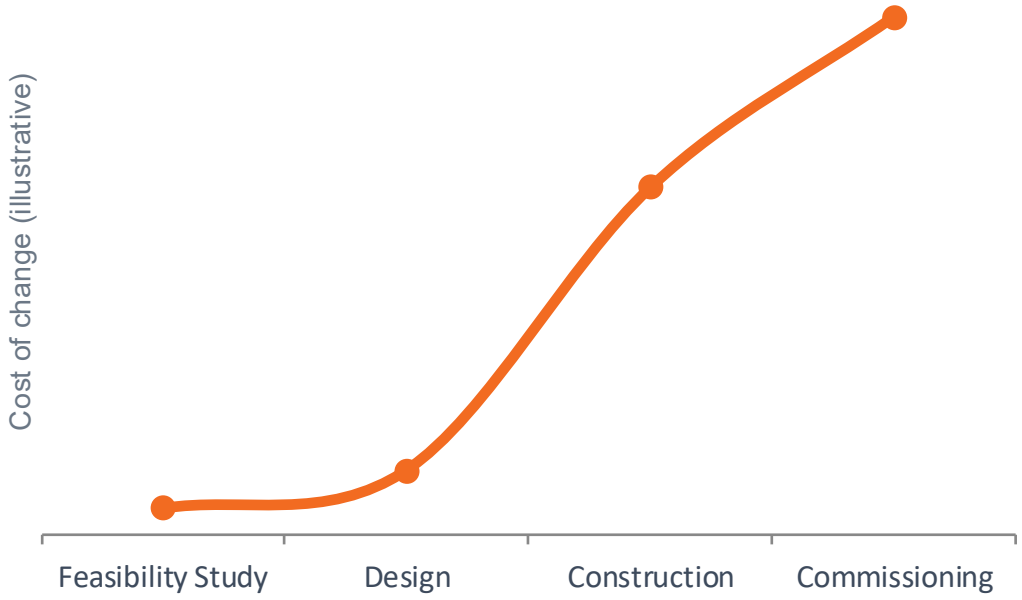
1. Determining the extent of the demand
2. Scope of investigations
3. Financial objectives
4. Service objectives
5. Statutory approvals
6. Information
7. Public consultation
8. Recommended design

WHY THE DESIGN CHOICE MATTERS

It is vital that the correct design is chosen at this stage.

Picking the wrong design, or changing it once started, can be disastrous.

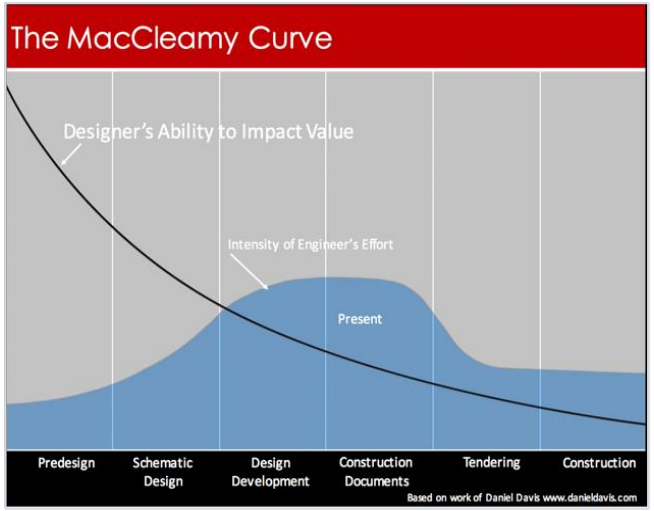
Late design changes cost the most



The earlier, the cheaper

Changes made during feasibility and design cost little. The same change during construction or commissioning is expensive.

The evidence: influence vs. cost



Patrick MacLeamy FAIA, LEED AP
Chairman
Executive Committee + HOK Board Member
2004
patrick.macleamy@hok.com

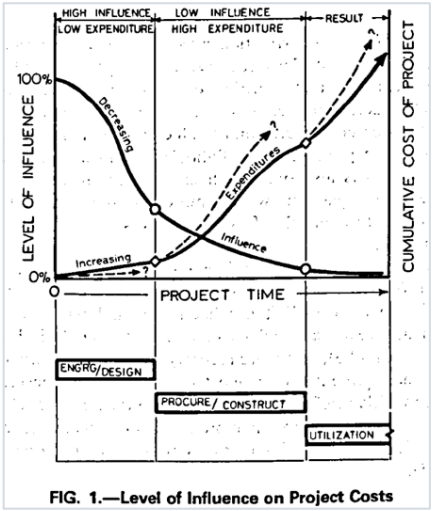


FIG. 1.—Level of Influence on Project Costs

12600 DECEMBER 1976 CO4

JOURNAL OF THE CONSTRUCTION DIVISION

DESIGNING TO REDUCE CONSTRUCTION COSTS[a]

By Boyd C. Paulson, Jr.,[1] M. ASCE

What the designers must achieve

Assuming the feasibility study recommends going ahead, the next stage is design. The designers have three aims:

1

Satisfy the client

Provide sufficient information to ensure the client's objectives are satisfied.

2

Obtain approvals

Obtain any necessary approvals and consents.

3

Inform what follows

Provide drawings and specifications for construction, testing and commissioning.

The design stage has its own cycle



It could be argued that the design process begins with the feasibility study: much of the information used during design is gleaned during feasibility investigations.

The Welsh National Assembly: the ‘Senedd’

Jan 2001

Work starts on the project

Late 2001

Work stops after disputes over the final design

Aug 2003

Work recommences

5×

Costs escalate to five times over budget



Proposed building



Site, July 2001



Site, August 2004



Site, August 2005



Opened March 2006



The Senedd, Cardiff Bay

A contract makes the project enforceable

DEFINITION

A formal agreement between two or more parties that is enforceable in law.

1. No project implementation is ever undertaken without a contract of some form between client and contractor.
2. A delivery contract commits the contractor to construct the works and the client to pay for it.
3. The form of contract (conditions of contract) is a legal document setting out the exact terms, liabilities and obligations of each party.

Construction contracts are covered in greater detail later in weeks 7 & 8

The most expensive, most active stage

It is the most labour-intensive part of a project. How the parties interact depends on the type of contract, but many elements are common:

1. Estimating (weeks 4&5)
2. Planning and programming (week 3)
3. Implementation of the works (the built items)
4. Risk; health and safety
5. Temporary works
6. Cost monitoring (week 6)
7. Execution of contract (weeks 7&8)
8. Claims and disputes

Intermission...



The hand-over to its users

Construction → **Eventual users**

The owner checks it works

A period in which the owner satisfies themselves that the project works in accordance with their requirements.

Defects Correction Period

The contractor must put things right before final payment is made.

Keeping it running

How long operation and maintenance lasts varies by project type, and some parts need regular inspection. The operating company (who may be the client) may contract out O&M under one of four agreements:

Operation only

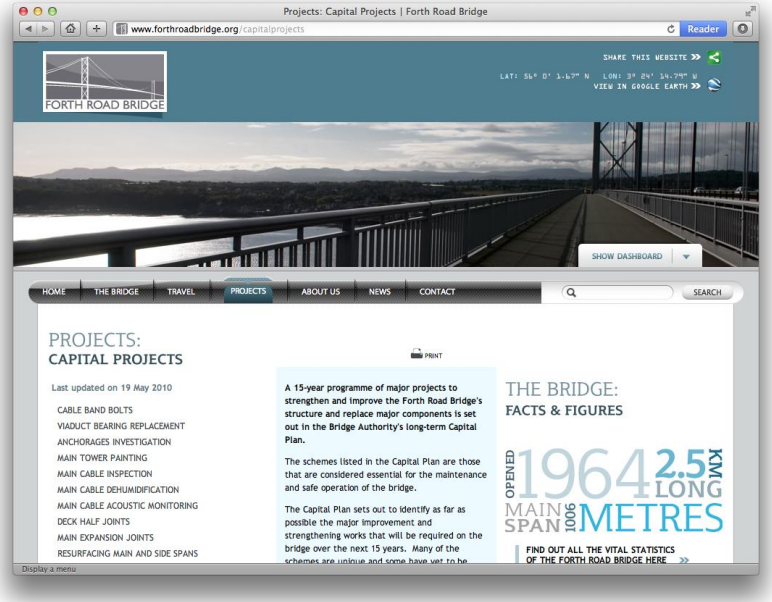
Maintenance only

Operation and maintenance

Operation, maintenance and training

Brings the client's staff to a level of competence to operate the project on their own.

Maintaining the Forth Road Bridge



PROJECTS:
CAPITAL PROJECTS

Last updated on 3 Oct 2012

CABLE BAND BOLTS
ANCHORAGES INVESTIGATION
DECK HALF JOINTS
SUSPENDED SPAN GANTRY IMPROVEMENTS
MAIN CABLE ACOUSTIC MONITORING
TRUSS END LINKS
MAIN EXPANSION JOINTS
MAIN CABLE INSP
Main Expansion Joints
MAIN CABLE DEHUMIDIFICATION
RESURFACING MAIN AND SIDE SPANS
RESURFACING VIADUCTS AND APPROACHES
CATHODIC PROTECTION TO PIER DEFENCES
SUSPENDED SPAN UNDERDECK ACCESS STUDY
SUSPENDED SPAN TRUSS ASSESSMENT
SUSPENDED SPAN PAINTING
PARAPET AND BARRIER TESTING
LOCALISED WIND BARRIERS
TOWER IMPACT STRENGTHENING
MAIN CABLE REPLACEMENT STUDY
MAIN TOWER PAINTING
DROPPED OBJECT CANOPY
VIADUCT BEARING REPLACEMENT

Closures and roadworks on the bridge

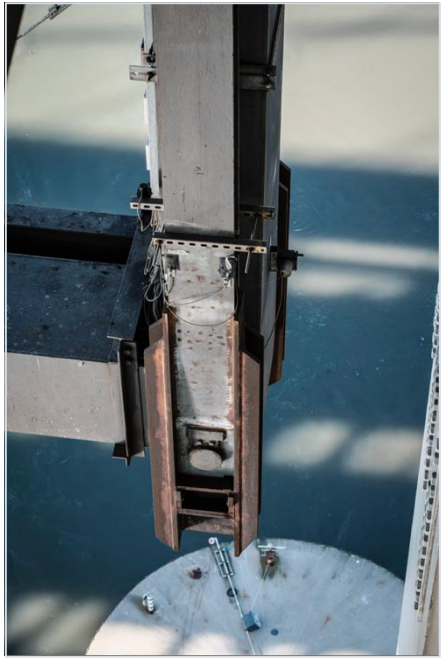


Clip 3



bbc.co.uk/news/uk-scotland-35001277

Inspecting the structure





The stage that gets the least attention

There may be no anticipated natural life for the facility, so the client is unwilling to commit time and money to a non-planned event.

BUT…

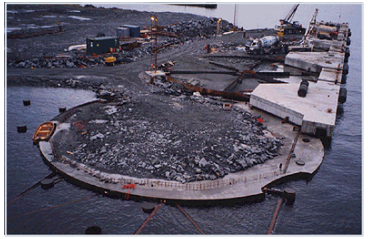
Many projects reach the end of their working life after a relatively short time.

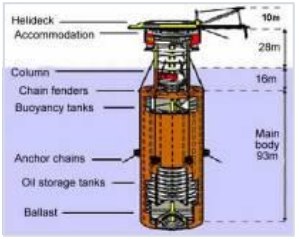
- **Nuclear power stations**
- **Oil facilities**

Brent Spar

1. Shell granted permission to dump at sea
2. International protests
3. Shell forced to reconsider decommissioning options
4. Towed to a Norwegian fjord
5. Now a port terminal at Mekjarvik, Norway













Passing on what was learned

Although a project may be unique, it will be followed by other projects with many similarities. It is essential that experience and knowledge are passed to these future projects.

1. **Safety hazards**
2. **Implementation and design methodologies**
3. **Financial management**
4. **Other risks**

…and more. This knowledge feeds the next project’s demand, closing the life cycle loop.

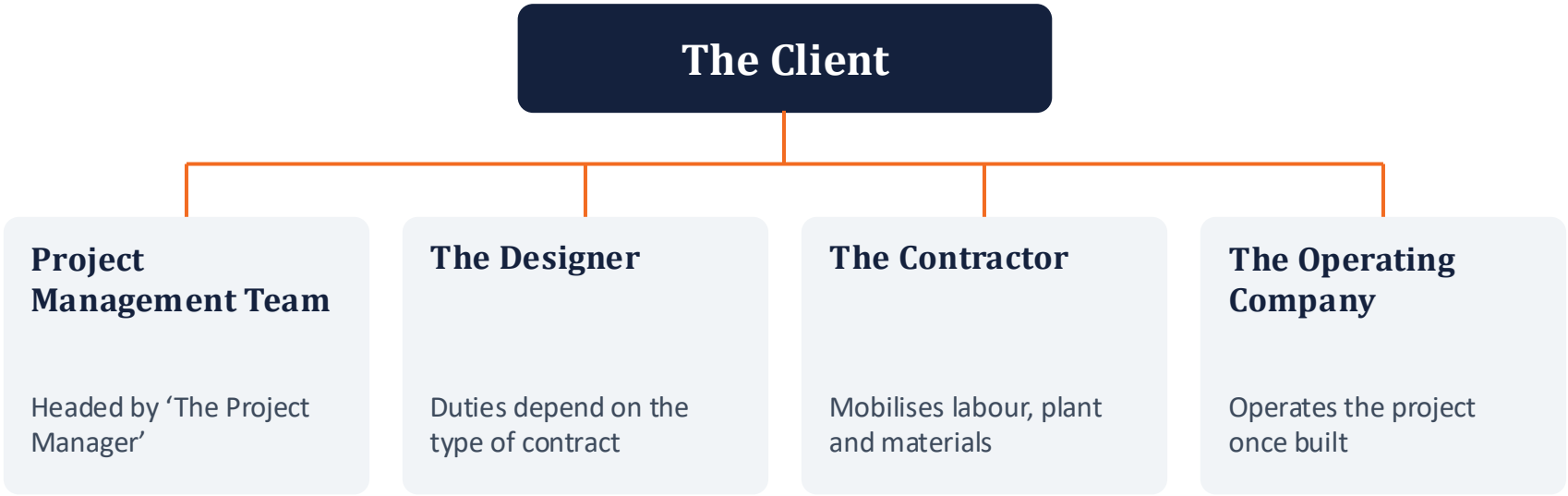
PART 2

The Project Parties

Who the key players are in all engineering projects

Who is involved?

The needs and interactions of all the players must be understood. There are three main parties (client, designer and contractor) alongside the project manager and the project manager's team.



The Client

The body of persons who have a need for a particular solution to a problem.

Also called the client, owner or employer. The completed project is the eventual solution and should fulfil the client's needs.

THE CLIENT'S AIMS

1. Obtain the best economic solution to a problem; whilst
2. Bearing in mind the safety of all who work on the project, at any stage in its cycle; without
3. Compromising unnecessarily the environment in which the project takes place.

Types of client

Central Government

Statutory boards and public corporations

Registered companies

Overseas bodies

The World Bank; United Nations Industrial Development Organisation; Asian Development Bank; European Bank for Reconstruction and Development

See real-world client examples on the next slide.

Client examples









European Bank for Reconstruction and Development

Asian Development Bank

Network Rail

Transco

Highways Agency

NHS

Saint-Gobain

Edinburgh – The City of Edinburgh Council

The University of Edinburgh

BAA

The FA

The Project Management Team

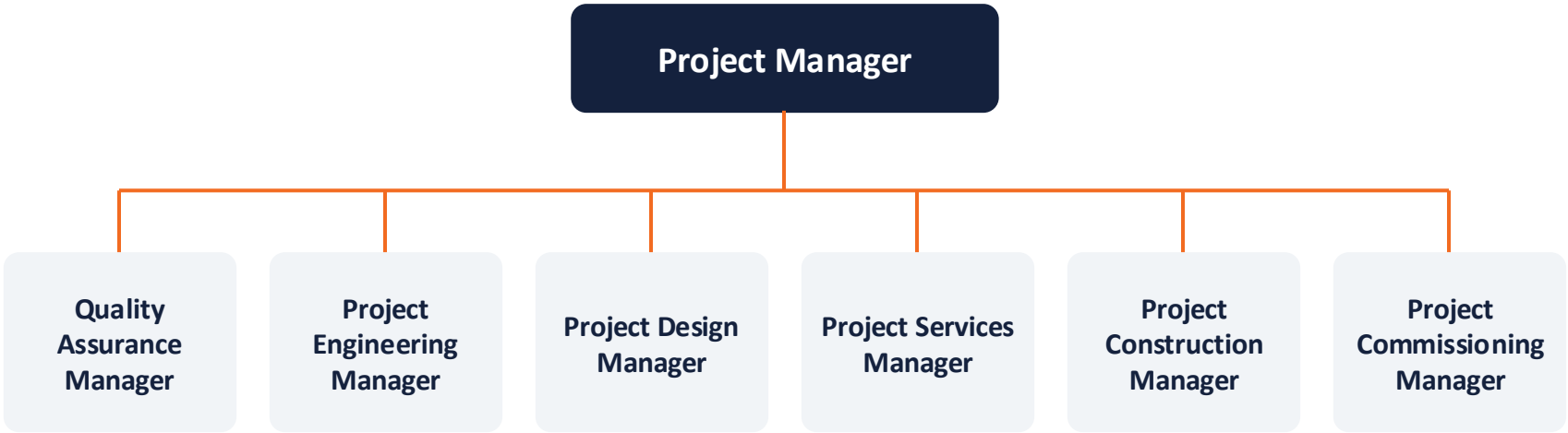
Interprets the client's requirements and implements the project.

Headed by the Project Manager, whose role is to:

1. Ensure achievement of project objectives
2. Control costs
3. Control schedule
4. Lead people and teams
5. Liaise with client
6. Liaise with contractors
7. Measure and report on progress

A typical project team

Because of the complexity of the average project, the project manager delegates key functions.



Project management companies

Examples are difficult to pin down: project managers come from many different backgrounds.

1

Same parent as the designer

Many PM companies belong to the same parent organisation as the designer.

2

Contractors

Some project managers are contractors.

3

The client's own organisation

Good examples: BAA and Network Rail. The University of Edinburgh also carries out its own PM.

The Designer

The designer’s duties vary with the type of contract used.

AT THE SIMPLEST

Only an outline design

AT THE OTHER END

Undertakes all design duties for the client and:

- Supervises construction
- Authorises changes to the design
- Manages payment details

Designer examples

Network Rail

FLUOR

ATKINS

FABER MAUNSELL | AECOM

Halcrow

Mott MacDonald

ARUP

EDINBVRGH
THE CITY OF EDINBURGH COUNCIL

ABB

The Contractor

Contractors specialise in the mobilisation and control of labour, plant and materials, and in the planning, programming and execution of construction works.

It is very common for contractors to ‘sub-let’ specialist items of work to smaller companies with greater experience in that type of work.

The contractor becomes the Main Contractor

The specialist becomes the Sub-Contractor

Main contractor vs. sub-contractor

Main contractor

- Contract to plan, programme and execute construction works
- May be responsible for design of the project (often sublet to a consulting engineer)
- May be a management contract

Sub-contractors

- Specialist skills
- May be nominated by the client or project manager
- May be used to share risks with the main contractor

Contractor examples







Bovis · Bechtel · Schlumberger · GallifordTry · Wates · Fluor · Air Products · KBR · Balfour Beatty

The Operating Company

Not all clients operate the project once construction is complete. Alternative bodies may do so:

A distinct new company

Examples

eurostar

EURO TUNNEL

M6toll™

A separate, independent (previously established) company

The contractor, if its original contract requires it to operate and maintain the project

Example: private finance

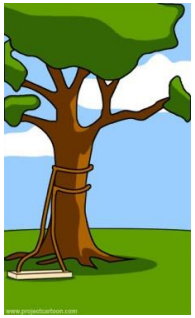


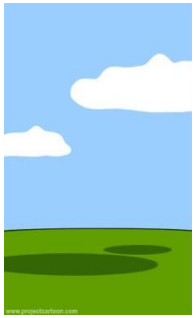
Consort healthcare

The client, perhaps as a separate division of its organisation

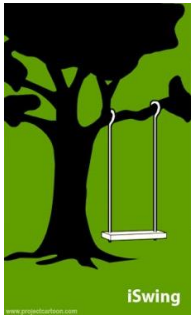
The real project management life cycle


How the client explained it

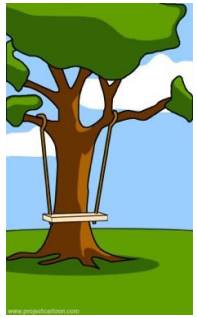

How the project manager understood it


What the feasibility study recommended


What was documented in the initial proposal



How it was designed

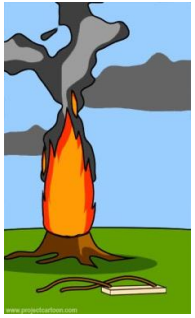

How it was marketed

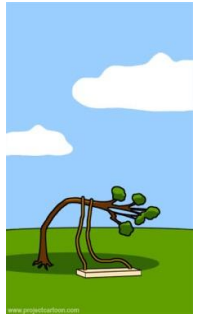

When it was completed


How the client was billed


What the client really needed


How it performed under load


The decommissioning plan


What remained 5 years later

Source: www.projectcartoon.com

REAL CASE EXAMPLE

ITER: a megaproject in practice

ITER

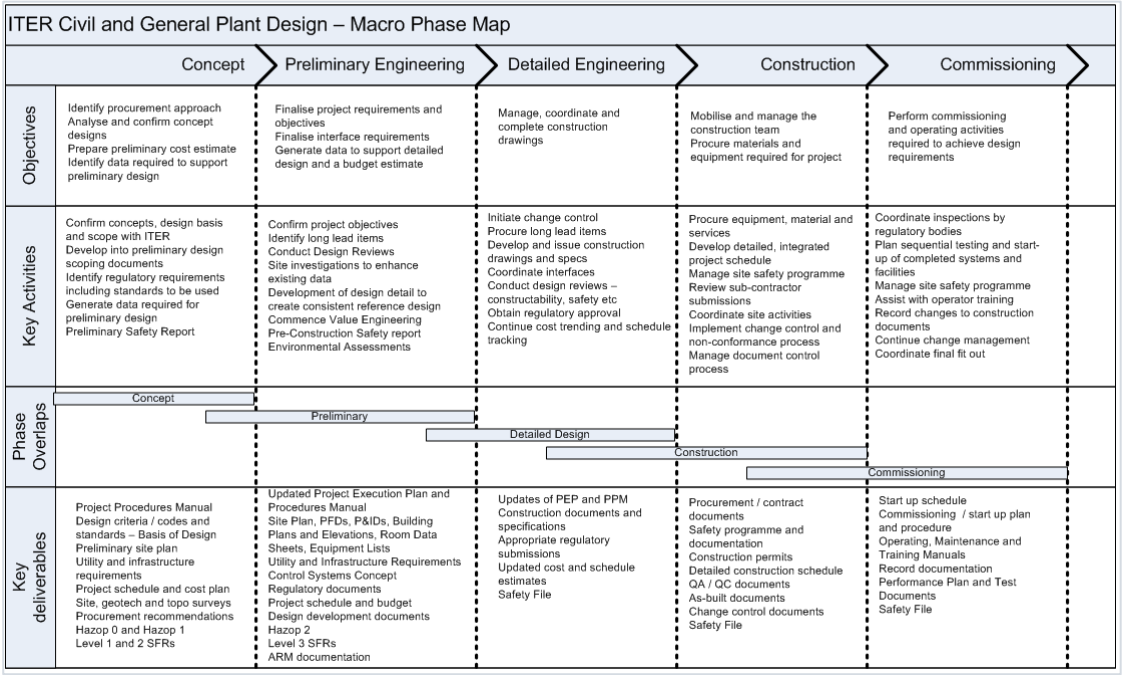
International Thermonuclear Experimental Reactor

Cadarache, France. In Latin, 'iter' also means 'the way'.



REAL CASE EXAMPLE

ITER: the life cycle as a phase map





ITER construction site



The Tokamak

Interested to read more? nytimes.com/2017/03/27/science/fusion-power-plant-iter-france.html

Thank you

Next week: Dr Fred Bosché – Project Planning (watch out for his announcements)