Session 1 Notes – Systems thinking

Table 1

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Flipchart Notes

Question 1: Are edges the right ones?

Edge 3 – not just public financing – private?

Edge 1 – can SDGS be used to link each systems aspect?

Adaptation reports/mitigation via carbon footprints > SDG approach – needs practical approach allow integration between public-private?

- Systems approach breaking down barriers?

How do you set project objectives with best systemic outcome?

- Financial? Community?
- What goes into C/B analysis now?
- KPIs/criteria (economic and financial benefits)
- Carbon benefit is – being included
- Other societal outcomes less applied
- Systems models can't fully reflect/represent human responses
- Turkey adoption of systemic outcome methodology – Istanbul sustainable urban management
- Societal impact benefits – can we use systems approach to capture
- Translation from feasibility to implementation

Question 2: How can systems thinking be used to create successful projects and delivery?

1. Stakeholder engagement from design – delivery?

2. Changing roles/ contributions of engineers in project from quantification to wider benefit/impact assessment.

3. Systems approach to support carbon/lifetime environmental address evolving uncertainties and new risks/costs?

4. Do we need to rest project method to apply systems approach before breaking down into components?

- Management challenges in ensuring proper overview + detailed management.

Question 3: Based on experience, what key factors determine achievement of societal outcomes?

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1. Need to measure many factors from project design- can be challenging to capture
2. Successful application of systems thinking tends to be for constrained requirements/ eg lower Thames crossing
- Strong client engagement/commutation
3. Are contracts a barrier to effective systems thinking?
- Possibly more impactful at start of project- procurement a major challenge
- Need to measure/access consistency and accurately across all impact/benefits?
- Recognize multiple stakeholder differences in priorities, views values- within a wider benefit assessment. Example, planning?

Other notes:

1. Systems thinking in real-world delivery of major projects and programmes - moving from 'outputs' to 'outcomes'

This discussion will introduce a new framework to describe the embedment of systems thinking in infrastructure project/programme selection, including how this can be combined with approaches to systems thinking in infrastructure delivery, before exploring how this framework may help projects/programmes to deliver broader societal benefits. Specific questions will include:

• Which criteria need to be considered for a systems-level assessment of infrastructure project/programme selection? Does the proposed framework cover these criteria adequately, or are changes required?

• Based on your experience of projects and systems thinking, what do you think have been some of the key determining factors in whether or not projects achieve broad societal outcomes?

Question 1:

Do you agree with the "Jigsaw" framework. Are the edges the right edges to frame the infrastructure approach?

- It seems that an assumption is made that this is all about public spending (edge 3) but should be about financing more generally, i.e. could be private/3rd party as well?
  But is it really private sector that goes into systems thinking? From a consultancy point of view, you only deliver the project and systems thinking should come higher up
  Generally, public sector thinking should deliver private benefits
  (Private resilience protection → encouraging private finance and insurance to cover resilience was helpful to ensure resilience in systems. Trying to tie back longer term impact to GDP. Every infrastructure had role to play to protect the economy. Difficult to evidence but had to show the criticality to the government.
  Particularly challenging in climate change issues

Are the other three edges about right? Should be more or fewer?
- SDGs are used a lot and a lot of the analytics align with this (almost like KPIs)
  From an engineering perspective, is the SDG framework as ubiquitous as in the financing side?
  Yes, more and more focus on these
  Some of Edge 1 can be linked to SDGs → health, equity, environment
  Private finance contracts are very driven by money and when bringing in SDG aspects into the contract, this is essentially rejected because this is usually not included in private finance contract and there is no money for it. From TfL view, there is push to greater resilience. These are also starting to measure the major footprints in major projects. At the moment, are investing

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to build knowledge to know how to do it in a practical way. Time and resource is very limited, particularly in the public sector. Can see benefit for both sectors, but are essentially driven by different drivers. There needs to be an emphasis on the monetary benefits of the framework, e.g. what are the savings or resiliencies etc. Otherwise the private sector will not be interested.

So the discussion is about project selection (edges). Bit in the middle is about how to implement it Thinking about how to select projects with the best systems outcome.

What is the CBA in the context of this discussion (in government). What constitutes a benefit?
- It is evolving. 10 years ago, say roads project, would have looked at cost, journey times, safety (accident likelihood) and then determined somehow (perhaps unreliably) the economic benefits within lifetime of infrastructure. Now more sophisticated, monetising the benefits of carbon for example can give you a figure through carbon pricing. Struggling more with societal outcomes, such as skills and community outcomes, difficult to predict positive and long-term societal outcomes. Think that in the UK we will start doing big UK infrastructure projects in the way that have done international development projects abroad and looking at outcomes and how to realise those through drawing chain between inputs and outcomes (Foreign Office did project in turkey to develop blueprint for how to affect systems level change: Sustainable Urban Management for Istanbul and also did one for Ankara → considered loads of different aspects. Began with feasibility study but bits of it have been implemented.), rather than "problem to solution" approach. Would be interesting how to close the feedback loop on that (whether outcomes were completed). Not very good at feeding outcomes back to systems. There is a timescale problem, i.e. where is the horizon?
Interesting to think about what the impacts are on a much more holistic level.
- There was a very politically driven project (cyclist and footbridge across the Thames, Canary Wharf to ???) project. Benefits where focussed on the social aspects. Had a system engineering but found it problematic as still working in silos. Different teams (sustainability team, architects, etc.) had different interests
Key thing is to define systems approach → didn't have standards, had to go to ICE to find some standards (yellow book)
Need to find way to look at benefits and translate into the private sector mindset that is money.
- How to break silos?
There is still a perception that an engineer cannot be sustainable. Same perception in the private contract. Need to change the perceptions
This ties in with the stakeholders/agents
Did not have many group working aspects
Noticed that different meetings had different people. For decision making, need to invite people who have knowledge on the carbon footprint and architects for design, etc. Decision making committees need to be driven by key people from across different backgrounds that are connected to the project and the back ground of the project itself. When does the user come in?
Have a sponsor, who got the data. The person with the money have the power.
Ultimately the political dimension is crucial. (Should be driven by the people)
Planning system is the primary interface → when you build something or design something, should be talking to the end-user.
Sponsor team is the one who has all the information and the consultation.

Q2
Looking at all function within that. Does systems thinking make it convoluted and take more time?

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When designing damn in Exeter, had to do a 1.5 years of planning. Had to work with councils, fisheries, etc. Are some things needed and some aren't?

- Traditional engineering side of projects, that is the bit that digitisation and data-tech is going to vastly accelerate. So emphasis will shift away from that to doing the things like planning. So project time will not change, but the allocation will shift.
- Risk will be a big factor? When looking at how different outcomes will be from the prediction. There will be risk associated with that.
  Critical path analysis has been around for some time. Things are not linear. Some of the biggest engineering disasters have come from over-reliance on computer outputs.

Question: priorities and challenges are changing quite rapidly on putting project together, financing and asset ownership side and making changes to how you do things (net zero). This has knock-on impacts on other things, risk, resilience, etc. When things come from directions other than what you're used to, have you noticed that you need to do things differently?

- Ever since the Heathrow runway issues went to court, government have been highly concerned about carbon aspects (see HS2) to achieve Net zero. Have seen massive changes in procurement, supply chain, etc. in terms of how to reduce carbon. Carbon is one of the most comprehensive lenses to view a project through. Drives process.
  Still have body of opinion that views carbon considerations lead to results that are more expensive (wrongly)
  But Carbon considerations introduce uncertainty. Where do you draw the edge of what your carbon budget it? How do you allocate budget between, e.g. healthcare and transport, but also don't want to externalise the carbon. The problem with systems thinking is that it almost makes the box too difficult and introduces too many variables. Sometimes can get lost in the stems thinking.
  Perhaps it's partly around to the mind set of making one big decision to moving to making a cyclical set of small decisions. In the end, need someone (a group) to say we now need to make a decision rather as to avoid decision paralysis.
  Traditionally, engineers are trained to simplify down to something that is tractable. There is a tension between getting something done to thinking about it.
  System approach trickles back down to project approach. Needs superb management and people need ownership of the project. Trying to marriage the gap between being very critical and having an overview itself. Knowing where to go in and where to have an overview.

Q3 projects that have shown systems thinking and what are the determining factors?

- In the business case it is defined as an approach that the key person has a background in systems (or at least the curiosity). Need to have a holistic approach. Needs to have the benefit
- Benefit case very difficult to establish at the outset of a project. E.g. how to measure carbon in the beginning in traditional projects?
- Briefs are often very rigidly defined and there is a limit to how much systems thinking can be implemented. Driven by contracts which flows down to further contracts. Where partnered with a climate, leads more to systems thinking way. Lower Thames crossing good example of this.

So are contracts a barrier to systems thinking? → doesn't systems thinking need to be embedded throughout the whole project cycle? Reduces as you become more specific. ST has greatest impact int embedding when you set the procurement when you set the project.

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- Traditional procurement is a big problem. Introducing carbon is helpful but other outcomes (social) is not yet happened.
Issue is when policy makers ask for a solution, and have awful much more problem with education, etc. and then have the question of what is up to procurement
Need specificity and measurability. End up chasing your own tail → where do we stop measuring?
- ST seems to be a shift in values. How to implement nature, society into decision making, and how successful can that be into thinking this way.

Is the approach mainly governed by your area? Work environment, area you live in. There are clearly cultural influences and relationship that develop between organisations. People are not only values driven but also behaviourally driven.

Power of planning (something government is trying to alter). Getting the right balance between local and larger influences.

The housing question is constrained by planning and green belts and other complicated things

This is also to do with education, culture and tendencies.

Table 2
Daniele Fornelli- Geo Obs, Haris Alexakis- Aston Uni, Nikolas Makasis CSIC, Viviana Bastidas Melo CSIC, David Pocock-Jacobs, Chris Campbell-Skanska, John St Leger-HS, Chrysoula Litina-NH, Manar Alsaif, UoC, Dongfang Liang-CSIC

Flipchart Notes
Edges
1 Plenatary capacity

2. Stakeholder needs

3. Funding

4. Impact

- Details ? + Granulaty when planning
- Commercialization
- Big infrastructure not just about public

    Money -> overall funding vs deployment of public money + return on investment?

    Fundability?
     Capital for maintenance & repairs, etc.

- Considers level of influence or impact? Stakeholders considered equally or by levels?
- Need to decide who should do what?
- Need to define framework.
- Barriers to systems thinking – lack of skills to apply it
    → Scale
    → Availability of expertise
    → Framework

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- Availability of skills important in addition to availability of resources
- Convening complex set of parities, eg. Aligning industries/ contractors
- Success depends on honesty of people, consider what drives them.
- > can be address through the 'right' commercial model?   > value for money > honest & trust
- How to incentivise the spectrum of people and their behavior?

- **Balance of framework -> commercial vs public ownership**
- Decision making? By multiple organizations?
- Edges missing how to define problem and level of problems?
- **Needs of stakeholders should be at centre**
- How to know that we have identified the real problem> (thinking of higher level drivers)
- Systems thinking drivers you for problem identification, then sends you down solutions routes – >view >solutions
- In….? and data -> gather throughout

Question 3 Project selection vs delivery

Key elements in success:-

- Use of systems thinking in managing different aspects of project
- Having expertise and big picture view
  - one of the problems is engagement
  - Culture, how to persuade industry actors to improve products?

  Need more integration, less delegation of different bits that are very related
  - Marking your own homework does not work eg, Boeing & Grenfell
- How do you respond to failures, eg. Aviation sector investigations vs. nothing in health sector

Other notes
Roundtable 1: Systems thinking

- First thing to explore is whether the edges of the system approach make sense
  - Edges:
    - Planetary Capacity
    - Stakeholder needs
    - Funding availability
    - Impact of projects
  - High level descriptions - but what are the detailed descriptions of the edge principles? (initial confusion around edges)
    - e.g., ownership depends on contract
    - Ned to consider commercialisation
    - System thinking is part of everything, governance, commercial, delivery
  - Edge 3: Money availability

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- Large projects: not only about public money, quite often we need public money to demonstrate confidence and thus bring in big investors. Right deployment of the public money
- Assumption in 3 that public pays, but that is too simplistic - word public is not quite right - perhaps fundability/ability to fund
- How do investors get money back?
- Most buildings are already built, new building portion is small, old buildings largely not well instrumented - case study on refurbishing - external insulation for heating, adding heat pump, investing on building to sell later
- How do we go about adapting existing buildings to new conditions/needs?
- How do we tackle fundability issues? - Edge 3 & Edge 2
  - Level of influence and determination of stakeholders
  - Political influence
  - Are stakeholders considered equally?
  - Who has responsibility? Who among stakeholders has responsibility?
  - Who should do what? - Needs to be clear
  - Assets where developers are maintenance holders as well
  - It can be helpful to have clarity on who manages/maintains/owns/constructs/etc.
  - We need to define framework in which we are working, scale
- One of reasons systems thinking has not been used at great extend is lack of skills to apply it, not many people have the skills to apply it, in terms of scale, you wouldn't use a systems approach, you cannot afford an expert.
- Does planetary capacity include skills, training of right personnel?
  - Natural resources presumably include skills
- Commercial interfaces: how are teams brought together? Construction/Maintaining/Developing/etc.
  - All parts are of the system, construction,
- Contractor, subcontractor, operator, client, user. A lot of the system dynamics depend on honesty of people/organisations. What is it that drives individuals? (money)
  - We need data transparency
  - But even when it exists, humans use it to their advantage
  - A human failing
  - We do not have a right "commercial model"
  - UK Government's approach is monetising everything that can be monetised
  - Value for money, honesty/trust, human interactions, and failings
    - How can we improve this?
    - You cannot change human interaction, as spectrum in people and their behaviours
    - If you make It difficult to follow a system, people will not follow it
    - Observed human behaviour needs to be key in system design
    - Society we live in is about 15% of globe, 85% of the world is very different in terms of life experience/priorities
- Does Asset management need to be profitable?
  - If you have people paying to use trains, and money coming in, and you need to spend to maintain trains, if at the end of the year company makes profit EVERYONE is happy, otherwise NOBODY is happy
  - Depends if service delivered is good
  - Data suggest balance is wrong - is public ownership the right answer?

- Scale: where do we apply framework? You need to define the framework, where are the boundaries? What does it include?
- Is problem well framed? Where does the framework apply?
- First decision is to decide whether you need to apply framework at all - what is the need? Do we need to construct something new or do something on existing infrastructure?
  - Edge 4 accounts for this?
  - Could it be the centre in the diagram?
  - Stakeholder impact - usually vulnerable people do not have influence or power, they are impacted by stakeholder decisions
  - Proposal needs to be clearer, is systems thinking the solution, to approach, the question,
    - You have a problem - which is an input
    - Outcome becomes a solution, we do this
    - What is the impact of the solution?
    - How do I prioritise thing in the process?
    - Framework is introduced after you have defined a problem
    - How do we get to the real problem?
      - In case of transport: idea - do we need to travel?
      - What is the real driver?
      - System thinking drives you "up" to find real problem, then go "down" to select best solution
- Contingency needs to be accounted for
  - Is sufficient information gathered?
- Experience from the table:
  - Different scales and applicability of system thinking
  - Different contracts that need to be managed, safety, cost, program
  - Interfaces creates complexity, but need systems thinking to tackle that
  - Crossrail did not do this right
    - people did not look at how project was going to be managed
    - Split jobs and everyone focused on their own task
    - Tunnelling project, did not think about how they would get passengers from A to B
    - HS2 uses lessons learned from Crossrail
  - Find somebody to understand system thinking is difficult - prior to Crossrail single person doing Systems Thinking, tides are changing now, more people focusing on using Systems Thinking
  - Problem is having big picture view and expertise
    - someone comes to put 10 km fence, they know about fence but do not understand land boundaries or how they influence train lines, etc.
  - Culture of industry that we work in, trying to bring people and drag them in the modern world, lack of advanced thinkers, a lot of people who are entrenched in old way/specific way, and to get them to improve that product/method you have to do a lot of work!
    - How do you incentivise change?
  - Many examples of bad systems thinking, lack of communication and honesty, Grenfell tower, Boeing 737 max
  - "Marking your own homework does not work"
  - Books from Matthew Syed on this

Table 3
Fraser Perceval (Jacobs), Fiorella Dell'Olio (CSIC), Mark Enzer (Motts MacDonald) , Tim Embley (Costain) , Anne-Marie Friel (Pinsent Masons), Adam Box (Topcon) , Farhad Huseynov (CSIC) Haitao Lan (CSIC) Ajith Parlikad (CSIC)

1. Edge Approach Priority

   - Good structure

   - Accessible language so that people in the industry understand and be satisfied.

   - The challenge is always the new academic view.

   - You get people over-thinking the language because everyone wants to sound very important but in reality you end up losing engagement. The biggest challenge is getting the engagement at the right level.

   - Structure/regulation need to pass development stage: Assessment of a project happens at the planning and development stage and that early stage in any project lifecycle so by the time most people in industry start working on projects, there's a kind of specific structure in place for assessing that, it's really heavily regulated. It's really intensive, really expensive. So once you get through that cycle, you still have to look at biodiversity.

   - Sponsor for project needs to make the case and it is a very complicated process.

   - Funding for activity should be made available. Initial funding should be there before you start planning and get to the development stage

   - Politics – powerful environment that could change hard work in framework

   - Need to be awareness of today's challenges

   - Limited funding is one of the main challenges

   - To govern on decisions we need a structure to follow
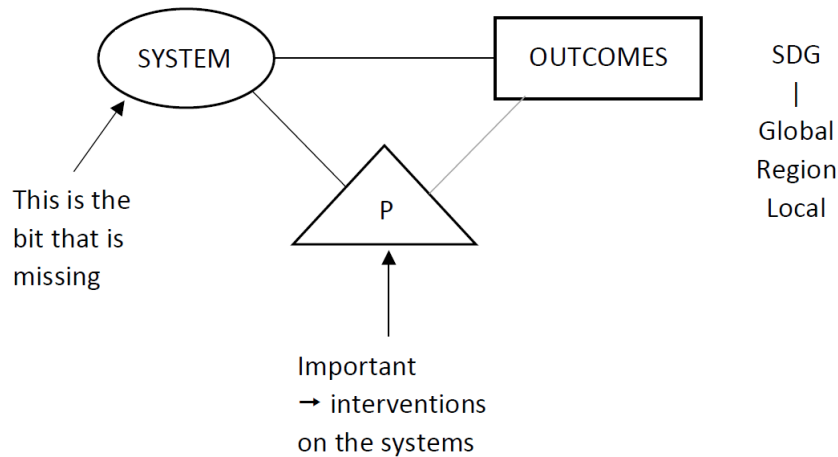
2. Project → Maximise Societal Outcomes

   - Baking into contractual obligations

   - Risk → legal → contract → passed into supply chain

   - Importance of data from the design stage– there might not be a need for assets → extending life of assets instead by using data from inspections from sensing systems: Smart Infrastructure

   - Closing the gap: if you've got a project somewhere else excited, you're going to use the experiences helps bring that knowledge, close that gap between industry and environment. As a system of knowledge. Knowledge → bringing ecosystem → link to other sectors → MMC → manufacturing → solving construction issues.

   - Sharing data in life of project: HS2 → visitor centre – good engagement

- Narrative for society, e.g. HS2 – speed V capacity

- Future proof: The operating environment of the future is a net-zero environment and this is an interesting challenge.

- Encouraging people in the team to think about 'systems thinking'

- Programme sponsor – critical – checks & balances

- Contractors & consultants need to be paid to do it → role of professionals to 'influence' (contract + finance + measures)

- Project life – things change → structure around outcomes

3. SAID – new stuff

- It is very important to have that system view for delivery but we need to start to think about he infrastructure that we already have, not just for new stuff

- It is really about interventions on what we already have

- System thinking is about the whole thing – whole build environment not just the new stuff. It is to see the whole thing.

- Instead of starting with planning we should start with 'use' because that's where everything else needs to come from

- Four elements → before you move to centre

- There's a difference between the product impact on the system and the system impact on the outcomes. And what we shouldn't do is to think that somehow projects have an impact directly on the outcomes. There's something in between, which is the whole system.

Graph Idea (Mark Enzer)

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SYSTEM —— OUTCOMES

SDG
|
Global
Region
Local

This is the
bit that is
missing

P

Important
→ interventions
on the systems

- When you do something like HS2, with the intention of increasing capacity for a purpose to improve national productivity, we know well that there are going to be some health outcomes and big environmental, economic and social facts, which are more than just increasing capacity.

- It is true that the outcomes would very rarely be exactly what was expected. But not necessarily just smaller because there might be some other outcomes which happened, which are better, but they weren't anticipated. They weren't part of the visual business case. Because it's a complex system. You can't be completely in control and so the outcomes that you get will be probably what you aim for, but other things as well, with a different 'shape'. It is important to be able to understand the system and its relationships. The examples of the health outcomes is not just to build a T hospital. That's something that maybe we need to do, but also, health outcomes come from reducing air pollution, making more parks or encouraging more people to walk. So the outcomes are complex things in relationship to the system, but it's not impossible to understand. Mapping is useful to understand all the possible connections.

- The challenge is articulating the outcomes: We cannot completely control the outcomes and there'll be all sorts of unanticipated outcomes, and some good ones. It is important to keep a close eye on good unanticipated outcomes, as it is also to learn from the feedback we receive. In this way it is possible to understand the relationship between the product system and the outcomes and make interventions to improve them

- The key thing about a public system is that you cannot control it but you can understand it better and the digital help can help that process in reaching better outcomes comes.

4.   – Your experience on projects and system thinking. What are key factors?

- Contract are an important component but it's all about how you structure it

- More and more collaborative types of questions

- How collaborative contracts help?

- Structure of contract – how you deliver

- The way we currently work – systems

  ⇒ Financed CAPEX V CAPEX

  ⇒ Disjointed

  ⇒ The phase investment

  ⇒ Detailed design → you lose the opportunity

- Project delivers 'outputs' not outcomes: We cannot really expect a project actually delivering outcomes for the society and for nature. It's too much to expect a project does deliver directly into the society. However, projects can contribute to the delivering of the outcomes together with other projects and contributors and in conjunction with other factors.

- System thinking is on the rise in policy. For example: make better prisons in South Wales – i.e. provide local food sourced locally, lower carbon intensity with the outcome of improving prisoners wellbeing and health. what they've been able to do is to map it so that you can see how the outcomes are improving in relation to how the system works, and see what the interventions are.

Table 4

Carlos Laguna Sanchez-Motts, Shelley Arora-Tailby CSIC, John Pelton-Costain, Olly Wright-Aviva, Sharon Duffy-Thames Water, Keith Bowers-COWI, John Allum-UK Parliament, Manu Sasidharan-CSIC, Jennifer Schooling CSIC

Question 1: Systems thinking in real-world delivery of major projects and programmes – moving from 'outputs' to 'outcomes'.

Which criteria need to be considered for a systems-level assessment of infrastructure project/programme selection? Does the proposed framework cover these criteria adequately, or are changes required?

Edges are the limits of the system:

- Planets capacity
- Governments financial capacity
- Needs of the people
- Impacts we want to have

Where does regulation fit in? Can be a key driver for decision making.

SD - regulation forms part of planetary capacity

JS – regulation ought to be a servant of the need

JP – regulation forms part of planetary capacity

JS – is regulation a tool to define these things in the framework? Public spending?

JP - Is regulation the lining of the proposed framework? It does need to be on the diagram

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KB – in his industry regulation treated as a stakeholder.

CLS – it is pervasive to the edges

KB – perhaps role of regulation to keep the balance across the edges (needs). Currently that is not how our regulation is drafted.

- Regulation should be developed in recognition of need.
- BUT regulation can be contradictory, e.g. water purification vs carbon

Regulation needs to be designed with a systems approach too.

Regulation has a role to keep the balance between all the needs – but currently designed in isolation.

Regulation struggles to keep up often BUT can be a GREAT ENABLER.

Where does skills and upskilling fit in?

JP – fiscal policy. Public spending looks like affordability rather than value which would be the (System view). Availability of money should be about availability of resources. Public value framework has to drive spending.

Public spending – feels like 'affordability' rather than value.

Shift focus to resource availability - Public value framework.

Value needs to be Whole life and systems.

CLS - Sometimes changes in policy can drive availability of money. Preventative policies rather than reactive policies. For example, health interventions decrease hospital building / 'active' travel instead of roads.

OW - Consequence of EV – heavier vehicles. Do the roads need greater maintenance? Designing needed for the unknown.

KB – Road charging. Need to think broadly about how road users use the road. Currently based on emissions.

Design for changing conditions and parameters. Think broadly – e.g., road user charging to alter vehicle routes.

How do we factor sustainability and health into value decisions and user choices.

Do we need more emphasis on nature-based solutions in the framework? E.g., in S.A.I.D framework? CLS – could be related to number 5?

Based on your experience of projects and systems thinking, what do you think have been some of the key determining factors in whether or not projects achieve broad social outcomes.

At the 'system' level – how do we take systems thinking beyond a single organisation?

- o Collaborate on project delivery
- o Look at wider (eco) system outcomes:
  - E.g., 2012 Olympics – good outcome for River Lea;
  - Chicken farms – bad outcome for River Wye

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There is a need for multi-dimensional master-planning at district and regional scales.

Managing the boundaries between authorities – within and between infrastructures.

Aligning outcomes with funding capacity e.g., GLA convening LA's – regional focus to enable systems thinking and outcome-based cross-cutting policies.

KB - Regional focus will get systems thinking emerging and integrated into thinking

Framework sets a mindset for project selection and delivery.

Is there a 5th side of capability- skills, capacity, resource supply chain. 4th side – Resources. Skills necessary – does the rectangle need to be a pentagon? Go back to a square - Public spending to be 'availability of Resources' captures capability and skills. Needs to have a good alignment with outcomes intended.

Example: **Crossrail**

+ve – good example of systems thinking. Delivering a great outcome and impacts, re appreciation of delivery complexity.

-ve – Internally - underestimated the requirement of a systems thinking. Had a 'boundary benefit' regarding funding.

Heathrow Terminal 5 - +ve outcome regarding civils, -ve outcome regarding baggage handling

Heathrow Terminal 2 - +ve outcome as learned lessons re. baggage handling from Terminal 5.

Olympics - legacy – themes – capability – objectives – systems – sub-systems – requirements.

Olympics - inclusive design (including religious sensitivities).

Framework needs to add culture alongside agile leadership. Good working culture, clarity of organisational objectives. Framework needs to allow for challenging and taking a step back. Agile leadership needs to embrace a good working culture.

Contrast between moon landings and shuttle challengers.

Allow for flexibility within and between SAID elements.

OW – system to not have thick edges.

JP – need to think about culture as one of the systems in the System of Systems approach.

Table 5

David Simavorian-Accenture, Dee Dee Frawley CSIC, Peter Hewitt-LOR, Mehdi Alhaddad-TfL, Alejandra Masia-BP, Nicky De Battista-Epsimon/CSIC, Chiho Jeon-CSIC/CAU, Paul Fidler-CSIC, Sakthy Selvakumaran-CSIC, Scott Steadman, BSI

Do you agree with the 'jigsaw' approach to framing infrastructure project/programme selection as a systems problem, and do you agree with the jigsaw 'edges' that have been proposed? Are these the right four 'edges' to frame project selection? Should there be more, or fewer, edges

The group liked the jigsaw approach but questioned the 'hard edge' for Planetary Capacity. This might need additional levels depending on scale. For example, you could be planning a mobility system for a city, a broadband rollout for a region, or a project at a global scale. What is the policy environment for each? Must think differently for each scale. How do you demonstrate that the systems approach for each project addresses global issues? Both national and global boundaries are needed. More edges? i.e. Looking at connecting the UK to a global workforce - how do you prioritise actions, focus on airports?, focus on visas and immigration?....   This is different than a project for example of laying fibre optic cable in a city. How do you do this on a global scale. You will need to ask different questions.

Bring stakeholders together into the model early on.

How can systems thinking be used to deliver the right project right? Do you agree that approaches such as SAID are the right models to be applied to project or programme delivery.
Is the SAID approach sufficient? Are there any important considerations that it misses?

How does this work for the private sector who are commercially driven? Manage through public policy but the problem is that government structures and policies change i.e. housing policy switches between localism where decisions can be made by local councils to national housing policies. Also, meeting priorities such as zero carbon construction gets pushed down to contractors who were not part of the initial discussions. LOR example of the zero carbon hospital project. The contractor has been tasked with working out how to deliver this and has had to deal with constraints such as a policy requiring the removal of badgers living in the area which resulted in a 12-month delay. Lack of joined up policy as in other areas badgers are being culled.

Based on your experience of projects and systems thinking, what do you think have been some of the key determining factors in whether projects achieve broad societal outcomes or not? Some points to consider could be:
Do you believe that project selection or delivery has a stronger influence?
Have you had experience of applying systems thinking to project selection or delivery?
Can you think of times when you have seen systems thinking applied to different parts of the project lifecycle, and can you give examples of how this was implemented? What were the results?

Informing stakeholders and society early - before you expect them to make informed decisions.

- A key measure of success is management of risk – who own the risk? Who is the 'systems thinker'? Is is Government?
- Systems thinking and or joined up thinking is not common in the UK really very rare on real projects. Too much individualism in the UK for UNSTDs to work. The UK needs a Department of Systems Thinking. Who has the remit to do this? NIC? Need a framework on how to deliver this but not what to deliver. If we can demonstrate the benefits of system thinking, can we get engagement?

- Procurement often does not allow the type of collaboration required on a project to properly implement systems thinking. Again, involve all parties early on. What is the mechanism to model and make judgments of the system? Data and people in a room?

Table 6

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1. **Project Impact and System Value are not equal – there is tension between projects and system thinking.**
   a. Is a project a system?
   b. What do we mean by "project"? To call it a project, people focus on getting the stuff done. The key is how to get the right things done. A project manager doesn't need to worry about system thinking and doesn't recognize what impact they are doing on this project could have on the whole system.
   c. You cannot expect a project manager to think about the long-term impact.
   d. Silo is another way of talking about project thinking. In order to get the whole picture, we need to look into individual elements, but once you do that, you neglect the whole view again.
   e. Deliberately fixing "simple" variables for good reasons, but doesn't necessarily deliver valuable OUTCOMES (e.g., build an additional road but induce more traffic congestion) – requiring more fluid thinking than embraced in (civil) engineering.
   f. Broken model of truth for a project?
   g. How to attribute value? Do we have to deliver a project all in terms of cost?

2. **Model-based engineering**
   a. Are we consciously deciding on the compromises?
   b. Model is a simplification of reality – is it useful? The initial model is simplified, and then more elements/details are added to it.
   c. Digital twins – the right scale for good scenario analysis? –> need quality insurance
   d. Potential contributors:
      i. Digital Twin Hub, CREOO demonstrator
      ii. INCOSE – Kristen knows the chair
      iii. Digital twin consortium
   e. Decision-making tools – are they flexible to use?
   f. Should become a learning process rather than a loading process.

3. **Evolving system**
   a. A project can be 10-15 years. The project is fixed for delivery, but the system is evolving. How to make sure what you design/decide today is still valuable/applicable 10-15 years later?
   b. How can you modify it to the changing environment? How do you adapt to it?
   c. Hard potential to be changed for the worst.
   d. We need flexibility on contracts!
   e. The assumption is the outcome of what we are trying to achieve. We have some points at the beginning of the project, and these points must be carried out throughout the project.
   f. The owner must own the responsibility for the outcomes.

4. **Communication between stakeholders**

    a. We don't allow people from the left-hand side to know why this is decided (what is the intention) by the right-hand side.

5. **Get system thinking into practice**
   a. Green concrete is at a project level, not a system level.
   b. Different financial values due to different roles of stakeholders.
   c. Green book evaluation.
   d. Need regulation/guidance. For example, the EGC certificate assesses if the project is good or not from an environmentally sustainable view. (Carbon regulation? Carbon right?)
   e. Who gets to debate, and who gets to design? How do people/chair committed to the position know the basis for assumptions?
   f. Who owns the outcomes? Who is going to take the risk? PM is responsible for delivering the project.
   g. Have we got the right constrains? Need assumptions like how far you can think forward.
   h. My job is to do project vs how do I select a project.

6. **Other points**
   a. ICE model doesn't seem to engage automation?
   b. TRL for new stuff?