CONTROLLING SUPERPROJECTS– INFORMATION MANAGEMENT REQUIREMENTS

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Abstract

Purpose
This paper explores the problems of managing superprojects and identifies how a different approach to controlling them can reduce the incidence of cost and time overruns and benefit shortfalls.

Design/methodology/approach
Literature review accompanied by conceptual analysis.

Findings
Project cost and timing overruns and benefit shortfalls are very frequent in superprojects. These problems can be ascribed partly to the way in which they are planned is not taken into account in designing and implementing control systems, particularly the governance processes and the information they have available.

Practical implications
This article has serious implications for those designing control processes, governance and information management for superprojects. It suggests that if a new approach is taken, fewer superprojects will suffer from cost overruns and benefit shortfalls, because remedial actions will be taken earlier for projects which are experiencing problems, while learning will be fed back to those planning new projects.

Social implications
There will be saving of public money and reduced deferment of benefits that normally result from failed or delayed projects and reduced allocation of large incremental budgets dedicated to resolving problems.

Originality/value
The taxonomy of different types of superprojects is original, as is the idea of ambidextrous control, and the diagnosis of failure reasons lying in the nature of control and governance processes and the lack of relevant information available during the control process.

Keywords
Project planning, superproject, project management, programme management, transformation, bias, control, information management

Paper type
Conceptual paper.

Introduction

Definition of superprojects
Superprojects are defined in this article as ones which are very large, complex and risky, whether absolutely or relative to the implementing organisations. They may be composed of many sub-projects or programmes, and they may be national or global (Mossolly, 2015). Global projects may consist of a smaller project replicated in many countries, with special organisational challenges (Aarseth *et al.*, 2014). They include all what are called "megaprojects". Superprojects may not be transformational – they may just be very large (Locatelli *et al.*, 2014). Transformation projects are ones which result in some strategic change and generally have greater scale, complexity, and number and variety of stakeholders (Di Maddaloni and Davis, 2017, 2018), governance and duration. Their aims vary from aiming to improve business process performance Abe *et al.*, 2007) to achieving a long-term impact and influencing organizational and technical aspects (Janssen *et al.*, 2013). The latter,

researching the introduction of a new system, describe it as a transformation, when it could be seen as straightforward systems implementation, although it shared some characteristics of transformation projects e.g. number and diversity of stakeholders, scope creep, level of ambition, continuous change and uncertainty, and governance issues, lack of transparency, lack of insight into business model changes of users. We call such programmes transformation type A, or transactional (a term from leadership literature, where transactional leadership relates to task-related leadership). They do not transform the client but transform some aspects of how partners work with the client, because they are so large and complex.

True transformation projects lead to significant change in how an organisation works, including changes in business models. Their risks are not only transactional, but also related to task definition, how tasks relate to each other, and whether the desired outcome is achievable at all. One of the biggest transformations of all is business model change, where an organisation transforms itself to conduct business (with customer, suppliers and other stakeholders) completely differently, usually delivering a different kind and/or scale of value (Eweje *et al.*, 2012). Controlling all such projects is harder. We call such transformation projects transformation Type B. There is much research into the control of such projects (Lichtenberg, 2016; Flyvbjerg, 2009; Merrow, 2011). The literature on government IT project failures (e.g. Nelson, 2007; Weerakkoddy *et al.*, 2011) refers mainly to failures in projects which aimed to transform delivery of government services, particularly moving towards e-government. Here, while the IT project itself might be Transformation Type A, the overall project is definitely Transformation Type B.

Definition of complexity

Complexity creates its own problems - both in terms of recognising and measuring it and having strategies for managing it – and sometimes for reducing it (Christoph *et al.*, 2014; Dao *et al.*, 2016; 2014; Graansberg *et al.*, 2012; Kermanshachi *et al.*, 2016; Maylor and Turner, 2017; Maylor *et al.*, 2008; Maylor *et al*., 2013; Pundir *et al.*, 2017). Complexity is defined by factors such as

- The number, variety and novelty (technically and managerially, to the client and its suppliers) of activities;
- The extent of and dependence on external partnering;
- The "wickedness" or inherent difficulty of the problem needing to be solved (Bjorgo and Roiseland, 2017; Foss and Saebi, 2018; Ireland *et al.*, 2012);
- Ability to forecast different aspects of the project and its environment (time and resources needed to achieve tasks, quality of knowledge/uncertainty/risk applying to the tasks and the environment in which they are being executed), and
- The impact of or by the social, political and economic environment in which the project is conducted, and whether the latter are steady state or actually/potentially disruptive.

One of the issues relating to management of complexity is the need for innovation (Bjørgo and Røiseland, 2017), particularly in megaprojects (Davies *et al.*, 2009, 2014, 2017) to overcome problems, rather than expecting tried and tested methods to deal with things. Complex projects are also harder to forecast – superproject research shows that control failure is often associated with forecasting failure. Also, the more complex the project, the easier it is for mid/disinformation to be introduced, particularly in forecasting costs, timescales and benefits, and the harder it is to detect (Stone *et al.*, 2019).

Definition of control

Control is the process by which a project is kept on track – the data gathering, management, analysis and communication processes for predicting, understanding and possibly changing a project's time and cost outcomes.

Classic approaches to management information are essential to project control, such as:

- Documenting, securing, communicating, making accessible and analysable (knowledge management) and eventually archiving requirements, plans and performance;
- Transforming data into usable information, using where possible standard, recognisable and easy to use templates, and
- Archiving information to provide an audit trail of changes and information to support learning.

How projects, programmes and transformations are managed

The project decision-making process and execution process

The classic project management life cycle is as follows: initiation, planning, execution, closure, review. The initiation and planning of the project are seen as taking place at the beginning of the cycle, and thereafter the focus is on project execution, to deliver according to project requirements. This "waterfall" approach contrasts with the "agile" approach, where set resources are committed over limited periods to deliver products or outcomes that are developed in each cycle. The latter approach evolved mainly in software projects, after many failed implementations using the waterfall approach. It can be argued that the agile approach suits situations where much is changing in the project context, while the waterfall approach suits situations of greater stability (Papadakis and Tsironis, 2018).

Waterfall vs. agile

The idea that a project is best planned by creating a plan covering the project from beginning to end, in a series of stages which can all be foreseen when the project is initiated, the so-called waterfall method, is being called into question, partly because the information needed to carry out the end-to-end planning is simply not available at the beginning. This is for various reasons:

- There are genuine uncertainties associated with the environment where the superproject is being conducted;
- The project is exploring new concepts, ways of doing business etc. and
- The outcomes resulting from planned actions are unknown.

Scepticism about waterfall superproject planning is one reason for using the agile method is, with its central idea that a superproject can be split up into several discrete elements, the exact nature of which cannot be fully defined until preceding stages are complete. Short sprints may be seen as the best way in which to deliver projects. However, agile methods may work for projects which are information projects, such as software development, but where extensive physical resources are involved, the agile method may not work. The information needed to plan and execute later stages of a superproject may become even more uncertain. Some superproject inputs have very long lead times. Resource planning may require inputs to be secured long in advance. So, some superprojects are better managed by a mix of waterfall and scrum methods. Finally, as Budzier and Flyvbjerg (2013) have shown in their study of IT projects, there is no significant relationship between use of agile methods and success/failure.

Managing risks and uncertainties

As a project becomes larger, more complex and of greater duration (Choo, 2014), information about likely costs, benefits, resources and context tends to become riskier (i.e. with known statistical risks) or uncertain (i.e. with unknown statistical probabilities). Uncertainty management is an important topic in project management (Johansen *et al.*, 2014; Loch *et al.*, 2011). In superprojects, control must focus not just on whether the project is being executed as planned, but also on identifying when execution might not be following plan, whether the plan itself is reasonable, and whether risks and uncertainties have changed – are quantities and times beginning to differ significantly from what was planned, whether this is likely to be the case, and whether re-planning, acceleration or deceleration is necessary.

Other management aspects

Other aspects which need particular attention in the management of superprojects include:

- Different players' roles at different project stages, particularly the role of planners, implementers, project management or coordination offices, immediate and more distant stakeholders, and the different mechanisms for governance (Bernardo, 2014; Brunet, 2019);
- The project business case and how far it depends on needs and costs which are changing;
- Information's role in managing the project and the information flow between different players, allowing them to perform their roles and allowing risk and uncertainty to be managed;
- Project flexibility e.g. interdependence between tasks or activities, availability and flexibility of resources - the so-called "critical chain" of Leach (2014) - and flexibility of different activities' start and end times;
- Reasons for problems and delays at each stage and the fact that during a project, new opportunities or risks may appear, suggesting the need to replan to capture or avoid/mitigate them (Hillson, 2019; Johansen *et al*., 2016; Krane *et al.*, 2014), but redesigning/respecifying projects during implementation creates more problems, as does non-conformance of progress or final outcomes, leading to rectification and further cost/delay problems, and
- Human resource aspects of project management, especially capacity (determined not just by resources but by the quality of project managers and how they work (Dalcher, 2019) and the systems and processes that support them), the maturity of the organisation in relation to project management (e.g. does it have a long history of executing successful projects), whether the organisation is ambidextrous (Turner *et al.*, 2016a, 2016b; Turner *et al.*, 2013; Khanaga *et al.*, 2014) (able to continue with operations while managing change on some definitions, on others using, refining, and building on existing expertise) while exploring exploration (innovation and problem-solving) and mindful (again this has different definitions, conscious of what it is, what it can do, what it is planning to do, what the associated risks are and how they might be handled, and so on).

Project success - the role of information management

There are many articles on project success and failure and assessing it (e.g. Budzier and Flyvbjerg, 2013; Flyvbjerg, 2009; Davis, 2018; Janssen *et al*., 2013; Locatelli *et al.*, 2014). The Association for Project Management (2019) summarised these into twelve most important factors. These are listed below (Table I), along with their general requirements and the management and control requirements that apply to superprojects.

Table I. Role of information management and control in project success

Factor	General requirements	Examples of how the factor applies to superproject information management and control
Effective governance	Clear leadership; responsibilities, reporting lines and communications between all parties	Identifying the different levels and part of the project for which special governance is required may be important
Goals and objectives	Overall project goals clearly specified, recognised by all stakeholders, not in conflict with subsidiary objectives, while project leaders have clear vision of project outcomes	Realism in this area is particularly problematic, and this applies not just to goals and objectives but also to resource requirements and timescales, due to what may or may not be foreseeable
Commitment to project success	All parties involved in the project committed to success; lack of commitment recognised and dealt with; project leadership inspires commitment in others	This applies not only to the internal (client)team and major contractors, but to all contributing to the success of the project. This includes accepting accountability for problems and involving the wider team in solving them
Capable sponsors	Sponsors play active role in project; assume ultimate responsibility/accountability for outcomes	Leadership is needed, not just sponsorship, and this may apply separately to different parts of the project, particularly those where special difficulties or risks are required. Leadership may need to be transformational, not transactional

Secure funding	Secure funding base; contingency funding recognised from the start; tight control of budgets	Speed and way in which budgets are being used up, inward flow of funding, and risks associated with funding, need to be understood
Project planning and review	Thorough pre-project planning; regular and careful progress monitoring; realistic time schedules, active risk management; post-project review	Risk and requirements management may need to be given very high priority due to size and complexity of requirements. Different approaches to forecasting and knowledge management may be needed
Supportive organisations	Project friendly environment; the supports and resources activity and access to stakeholders	Conventional organisation for small projects is relatively easy to achieve, but superprojects may require a very different approach to organisation, perhaps even a new model of organisation. For example, a single project management office may not be enough
End users and operators	Engaged in project design; project team engages with users, who can take on what project has produced effectively and efficiently	This applies to internal and external members/stakeholders, so implies good and frequent information flows
Competent project teams	Core-team professionals fully competent; other team members fully competent; project team's positive behaviours encourage success	While the competence of a small team in a simple and familiar project may be easy to access, this is definitely not so for superprojects, so specific assessment methods may be required
Aligned supply chain	All direct/indirect suppliers aware of project needs, schedules and quality standards. Higher/lower tiers of supply chains coordinated	Especially careful supplier selection is required, particularly focusing on their successful involvement, as demonstrated by third party information, in projects of a similar size and complexity
Proven methods and tools	Good practice tools, methods and techniques applied to balance flexibility and robustness	This may not be enough – experimentation and iteration may be required, but not necessarily using the agile approach. Managing the workload of project managers is important, because if they are put under stress, the likelihood of errors and omissions will increase
Appropriate standards	Quality standards used to drive output quality Adherence to other standards regularly monitored to ensure best practice delivery	Transparency is a critical component of this, and this requires special attention to be paid to strong visibility at governance level of project progress and risks. Interim and final metrics for superprojects are often hard to establish, so need to be kept under continuous focus

Source: Building on The Association for Project Management (2019)

A problem that occurs in superprojects in construction and IT and government transformation projects is systematic underestimation of costs, difficulties and timescales and, less commonly, over-estimation of benefits or under-estimation of the difficulties of benefit realisation (Locatelli *et al.*, 2014; Ward, 2013; Flyberg, 2009).

One of the best studies of success factors in large programmes (Ward, 2013) reached several key conclusions, listed below, along with our conclusions concerning the control implications (See Table II).

Table II. Control implications of programme success analysis

Finding	**Control implication**
"Positive" programmes, i.e. those integral to business strategy, were more successful, while "reductionist" ones e.g. reducing costs, were less successful, with less senior executive involvement	Control must focus strongly on strategic benefits, particularly in relation to the strategic benefits

In many successful programmes the need was high, but readiness was low	The programme must be set up with a strong focus on improving readiness, and control must focus on documenting improving readiness as the project progresses
Successful programmes had a strong financial and business case, but less successful ones had problems with overestimation of financial benefits and underestimation of risk and problems	Control must focus early on these matters, and organisations must be prepared to make changes to or even terminate projects where the benefits and risks have been poorly estimated
Programmes cannot be planned fully in advance, although there is pressure to do much detailed planning upfront – this may not be necessary, but has benefit of engaging stakeholders	Control must not focus mechanically on conformance to initial estimates, but should be part of the mechanism by which governance processes lead to programmes modification
A clear vision of intended future business and organisational capabilities and models is essential for stakeholder commitment and is key to success, including unlearning old ways and practices and introducing new ways	Control, especially that based on value, should take into account not just immediate financial benefits, but what the organisation will be able to do once the programme is complete (exploiting the new capabilities), while also focusing on how the capabilities and models are developing
Big change programmes often require a portfolio of smaller change programmes, but few organisations have governance structures for this	A project or a programme management office is not enough for governance in this situation, as much control information is high level, related to changing capabilities and models across the whole organisation. Control information on this needs to go to a very senior team

Source: Building on Ward (2013)

Public-sector transformation success

There are many studies of success and failure in public transformation. The report of the UK's National Audit Office (2015) identified these issues as important in transformation success:

- Engaging stakeholders, especially users;
- Defining scope in different ways, including early exploration pf broad options;
- Balancing ambition with realism in goal-setting and basing goals on evidence;
- Planning for possibility of failure, including the possibility of de-scoping;
- Taking into account capacity, skills, supply chain, learning curves, implementability and operability, and the limitations of systems - basing decisions on how things work in practice;
- Simplification of policy where possible;
- The need for experienced programme management, strong involvement of leaders, tough prioritisation, strong direction and tightly managed communication;
- Realism about size and timing of benefits and about time to change culture and behaviour;
- Managing performance in different ways, including measuring interim as well as final benefits, and
- Using test and learn rather than big-bang approaches.

Project control

Control against the plan

At the centre of the discussion on project control is the idea that business case development, project design and project management processes can determine controllability, particularly if their information aspects are built in early to facilitate monitoring and control (Floyd, 2004; San Cristóbal, 2017). The focus of control is generally on

what is called the “iron triangle” of projects – cost, schedule and benefits, and what has been achieved for each at different stages of the project, but the relative importance of each varies in different projects, according to constraints, budget availability, external factors, and depending on the nature of the project, trade-offs can be made.

Benefits versus costs – the longer-term problem of benefit realisation

The need for control does not end when a project is delivered, because in most cases, that is when the flow of benefits (Badewi, 2016) starts, while project costs may continue in the form of maintenance and operations costs, as well as additional elements of the project that were planned for after the benefit stream was planned to start. If the benefits are much less than planned while post-implementation costs are more or less as planned, then the net cost of the project rises. Control disciplines therefore need to be applied to benefits realisation.

Transactional or transformational

The large literature on project control covers the information needed to achieve/improve control, the information processing needed, and the findings of research into success and failure of control (Lichtenberg, 2016; Perrier *et al.*, 2018). However, it focuses mainly on projects, where there is relatively little uncertainty about the parameters of a project e.g. costs, timescales. Known methods are applied to situations whose high-level parameters are well understood (e.g. small construction projects, implementation of stable software in mature situations e.g. replacing one piece of software by another with the same functionality, use cases and interfaces). Here, most risks (and so failures in control) relate to estimates of time and resources required to undertake tasks, delivery by suppliers, testing and the like.

For superprojects, the consequences of failure include serious project delays or outright failure, significant cost overruns which put the budget of sponsoring authorities to the test (Flyvbjerg *et al.* 2004; Lind and Brunes, 2015), and sometimes quality – what has been produced may not be fit for purpose. Many of the issues which lead to these failures relate to how information is used to plan the project and then to control it. The discontinuous nature of most of these projects and their “lumpiness” (the fact that they are composed of several major sub-projects or programmes, many of which are not similar to projects or programmes that have been carried out before by the organisation doing them) means that so there is little opportunity to learn from past experience.

This means that the information system to control superprojects is not like a normal operational system, which tracks flows of well-understood activity (e.g. in the supply chain or with large numbers of customers buying similar products), so that the system is being are used and tested continuously for its availability and accuracy. Nor is it just a very large classic project information system. It must to allow for many of the information management issues of superprojects discussed later in this article.

Data-driven project management

The development of the ability to manage (gather, store, interpret, use) high volumes of information has improved so greatly in recent years (Singh, 2014). That in theory should make a big difference to the control of superprojects. However, as we shall see, the superproject control problem does not lie with managing data, but with disinformation (Stone *et al.*, 2019). Many project task definitions and resource and timing requirements are based on expert judgements of what is required, and this opens up the opportunity for mis/disinformation and bias (Stone *et al.* 2019; Flyvbjerg *et al.*, 2009; Flyvbjerg and Budzier., 2011; Glass *et al.*, 2008). In business model change, for example, it may not even be clear to managers what information they need to determine whether their business model is working and whether the model needs to change (Parnell *et al.*, 2018).

A specific requirement in some cases is to manage corruption and fraud across the project cycle (Bach *et al.*, 2018). Here, the report of the OECD (2019) on the use of analytics is path-breaking, not in terms of its technical

approach but in terms of its recommendations, which relate primarily to countries where corruption in public projects is high, though its conclusions could apply to all large public projects. A particularly valuable part of this report is the identification of corruption and fraud risks at different stages of the project cycle. The recommendations do not relate to particular software or systems, but to taking an overt and data-driven approach to the identification and prevention of corruption.

Special problems that relate to information management - summary

So, in summary, management of information for superprojects faces several special issues, as follows:

- Keeping the much larger number of stakeholders informed at every stage of the project;
- Uncertainties about what is the real starting state of the superproject in some cases, requiring significant additional fact-finding, and problems with knowing the current state at any stage;
- Forecasting costs, benefits and risk when the scale and impact of the project is very large;
- The consequent much greater scope for underestimation of costs and timescales, over-estimation of benefits;
- Use of heuristics, biases, denial, dis/misinformation, overconfidence relating to present state and what is achievable, in a situation where so much information is estimated;
- The increased probability of fraud because so much is at stake (financial, reputational) – this can apply at any stage from applying from bidding to measurement, evaluation and control, and
- Different possible interpretations of success and failure, particularly when a project is politicised, including different ways of interpreting costs and benefits as applied to outcomes or timescales.

Knowing the unknown

The statement of Taleb (2007) that we cannot truly plan because we do not understand the future, so we should plan bearing in mind this limitation, is a warning to those who assume that control of plans is just a question of having the right data. As Budzier and Flyvbjerg (2013) point out, when the idea of project or programme failure is discussed, we must be clear what we mean. Do we mean complete failure to deliver the benefits, severe cost overruns or that a project takes far longer than planned? Their study identifies that severe cost overruns – in their study up to nearly 300% or in the worst case, project collapse, or severe delays, up to around 100% -are outliers. Benefits delivery tends to be within a tight range around the planned figure.

So, this means that there should be two main purposes to control. The first is to keep on track a project or programme that seems to be well-planned at or close to budgeted cost, time and benefits. The second should be to identify projects which seem likely to be negative outliers, so that whatever governance mechanism that is in place can swing into action e.g. to decide whether to cancel the project, to budget for increased costs or time, or to find ways to mitigate problems that may lie inside or outside the organisation e.g. with suppliers or beneficiaries. Where the project is one of several, whether concurrent or in sequence, whether in a programme or in a portfolio of projects that are less tightly related than a programme (Filippov *et al.*, 2014), another objective of control is to identify whether other projects are experiencing the same problems and/or needing the same solutions.

As Flyvbjerg (2009) identifies, infrastructure projects have perverse incentives for promoters to underestimate costs and overestimate benefits, while the larger the project, the more likely this disinformation is likely to have occurred. This problem, he finds, is accentuated by various other factors, such as long planning horizons, use of non-standard technology and design, involvement of many different parties in planning and management, absence of serious analysis of alternatives, changes to project objectives or scope, and lack of allowance for risk and unplanned events. Flyvbjerg's conclusion is that technical factors rarely account for the problems. He rejects optimism bias, on the grounds that the project management profession would have learnt how to avoid this, yet over time the incidence of severe project problems has not changed. He identifies political-economic explanations and strategic misrepresentation as the systematic problems, citing evidence from his studies in

which project planners readily admit exaggerating benefits and minimising costs in order to get approval. His views are confirmed by Glass *et al.* (2008), in their study of software projects. He also points out that it is convenient for public officials responsible for failures to blame optimism bias (often on the part of others), when the problem lies with how they conducted the project planning and bidding process.

Flyvbjerg (2009) recommends the use of reference class forecasting (Lovallo and Kahneman, 2003) to deal with this problem. This means taking an outside view of the project and using data from similar projects to establish real likely outcomes. For example, if projects of a certain type tend to overrun on time or cost by a certain amount, this should be factored into the budgeting and planning. However, reference class control is also required. This means examining the data during project implementation and identifying whether a project differs from plan at that stage in the same way as similar projects. Using this approach requires a significant change to project governance, including a much more transparent approach. It also requires a big external data set.

Flyvbjerg (2009) suggests that those responsible for project control need intimate knowledge of how a project was justified in the first place, and whether governance focused on removing likely exaggerations. He makes a number of very specific recommendations as to how to remove them, including peer review of costs and benefits forecasts, benchmarking and transparency for all stakeholders, and in the case of public sector projects, putting private capital at risk, but these are outside the scope of this article, other than to say that those responsible for project control need to know whether these approaches were used. A useful contribution comes from Martens and van Welden (2014), who argue that the uncertainty (lack of reliable knowledge about a project) and ambiguity (different perspectives on projects – see Pich *et al.*, 2002) of information needs to be recognised.

The above discussion leads to an interesting conclusion. The larger the project, the more likely it is to be transformational for some or all of those involved, but the greater the risks of mis/disinformation in planning (Stone *et al.*, 2019). Those responsible for controlling superprojects must take an ambidextrous approach. Here, "ambidextrous" in a different but related sense to that already used. As discussed above, the project needs transactional control – similar to the operational side of management covered in classic ambidexterity theory. This focuses on whether the project, step by step, phase by phase, is meeting its cost, timing and then benefits targets and whether the required actions are in place to keep it on track.

However, superprojects also need transformational control, which focuses on much bigger questions, such as whether the project plan is significantly unrealistic. This may be on the positive side, because there are big opportunities that have not been taken, or the negative side (costs and timings have been significantly underestimated and/or benefits have been significantly overestimated), so that the project planning needs to be redone, the project needs much more innovation, bigger budgets need to be sought, big delays need to be accepted and communicated, or the project may need to be cancelled). This transformational control must also focus on how the initial main project decisions e.g. scope, overall timescale, options reviewed, overall budget, were determined and reviewed and who was involved, and also on softer data emerging during the course of the project, such as that relating to the perceptions and attitudes of the main stakeholders in the project, as it evolves. The more the project is of Type B rather than Type A (and most superprojects are a mix of the two), the greater the depth and quality of soft information needed for control.

Given the very different nature of transactional and transformational control, it is likely that the people involved in each may need to be in separate though connected teams and may need different skills. Transactional control seems to match the skills of the traditional Project Management Office, while transformational control may need a team which combines leadership and analytical talents. Transformational control cannot be a one-off

audit, but must be continuous, like transactional control, as signs of problems may emerge at any time, even at the benefits realisation stage. The feedback loop from transformational control is particularly important, because it should stimulate greater awareness of failures that result from politically-based superproject planning.

Implementing transformational control in superprojects

Flyvbjerg (2009) suggests that overcoming the control problems requires taking an outside view, but it is this very outside view that is likely to be resisted by those involved in the project who have minimised costs and timescales and exaggerated benefits in order to get the project approved, and their resistance to it is likely to be throughout the course of the project until the gaps between plan and outcome are so severe as that they are no longer concealable. Our view on this is that where such severe governance problems exist, it is not to do with the superproject itself, but with the DNA of the organisations involved as sponsors or deliverers, so remedy must be sought at a higher level, which can only be political.

The conclusions and implications for information management in superproject control

Our conclusions from our above analysis are that those responsible for managing control of superprojects should focus on:

Governance

- The need for involvement, buy in and commitment of stakeholders to the planning of information provision and use, to support control throughout the whole superproject life-cycle;
- The need for strong information provision to those responsible for governance, properly updated and customised to different levels – project, programme, board etc., to support governance processes and to ensure alignment with business strategy and change management;
- Providing information on softer issues, such as stakeholders' satisfaction with project progress, awareness of project state, satisfaction with management of project, at each stage or very often, particularly to support the governance process;
- Paying much stronger attention to how those at different levels of programme planning, delivery and governance and different types of stakeholder absorb and use information, and providing them with information which is appropriate to this and understandable by those in different positions;
- Providing information summaries that support learning from errors and successes – within and across superprojects - in order to plan better and implement better;
- The need derived from all the above for control information needs to support ambidextrous control
- Being mindful/self-aware of the maturity of the organisation and suppliers/partners in relation to superproject management competences (Turner *et al.*, 2016a), risk management (De Carvalho and Rabechini, 2015; Kutsch *et al.*, 2013) and using assessment tools to quantify this, and
- Defining the information management requirements of project auditing right from the beginning of projects.

Technique

- Taking an agile approach to determining information requirements themselves, if the agile approach is used i.e. what the information requirements for control will be for each successive stage "spring" of the project;
- Exploring new sources of information e.g. use of IoT approach where appropriate in projects with lots of physical artefacts, development of user apps for the project team which provide their own information e.g. on when, where and how apps are used and the consequences of using them, use of artificial intelligence to identify true project status, and
- Providing better tools for assessing the possible ranges of outcomes of costs, benefits and timing and their associated risks and uncertainties.

Issues for further research

The main research implication from all the above is that the superproject management problem is just one example of a more general problem which has already been identified (Stone *et al.*, 2019), but which need to be dealt with using learning from a much wider range of management disciplines, particularly as change management (Hornstein, 2015) and strategic decision-making processes (Shepherd and Rudd, 2014), but also other areas such as leadership (Tyssen *et al.*, 2014; Coleman and Bourne, 2018), big data (Merendino *et al.,* 2018), cognitive bias (Montibeller and Von Winterfeldt, 2015), artificial intelligence (Auth *et al.*, 2019, Prieto, 2019), military strategy (Payne, 2018), and knowledge management (Ekambaram *et al.*, 2018). In some respect, the superproject literature is discovering phenomena that has been widely researched and documented in other literature, but in an interesting combination which does need stronger integration.

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