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A new focus in the empirical research of manageability in projects

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Abstract

The outcomes of complex projects regularly reveal the failure of management, when trying to control them towards a predicted outcome. This article reports on a study looking at the emergence of unmanageability in these projects. It takes as a point of departure that the occurrence of unmanageability cannot be attributed to a limited set of discernible decisions, but instead depends on broad trade-offs, often with double bind character. This then leads to the observation that a different approach is also needed to fight unmanageability. While individual trade-offs do not necessarily lead to unmanageability, the research identifies patterns of trade-off outcomes that can cause a project to spiral out of control. Finding coherence towards more manageable projects is shown to be difficult though, since the trade-offs are made separately in different phases of the project and on different levels in the project hierarchy. This article does make a case for more awareness of the coherence of trade-offs by referencing later phases in time and more operational levels in the hierarchy, and suggests aids to achieve higher manageability using such coherent approach.

Introduction

For a long time, project managers have tried to combat the emergence of unmanageability through hierarchical control mechanisms (Espinosa et al, 2007; Turnbull, 2012). These

mechanisms, however, do not acknowledge that origins and consequences of unmanageability often cross the borders between levels at which trade-offs are made. Early owners' decisions on scope and quality eventually have an effect later on manageability for project executers. And project executers' attitude in dealing with daily uncertainties has an effect on owners' abilities to stay in control of implementation time and cost. The way choices perpetuate through a project is the topic of this paper.

Methodology

In this research we have looked for the origins of the actual occurrences of developments that led to uncertainty in six complex projects by studying project documentation and carrying out interviews with involved project managers and engineers. Both methods were used to find the narrative behind evolving unmanageability. The projects were selected on both similarity for comparison and variety for comprehensiveness. With regard to the former, we decided to study infrastructure projects that contain an underground component, as subsoil construction typically comes with a high degree of technical complexity. They were also built in a physically and socially complex environment (many existing structures, land-use functions and abutters). With regard to the latter, projects were studied in three different countries, had different sizes and different ownership structures. Table 1 shows a list of the six projects.

Table 1: Overview of cases

Project	Location	Short description	Commissioning form	Cost (x Million, money-of-the-day)
RandstadRail/Souterrain	The Hague region, Netherlands	Light rail, converted from conventional train, tram and metro, with tunnel in the centre of The Hague	public	€446 total system, €127 for tunnel (planned)/ €242 (outturn)
Rijswijk Verdiept	The Hague region, Netherlands	Railway tunnel with subterranean station	public	€87
Central Artery/Tunnel Project	Boston, USA	Subterranean reconstruction of highway, new multi-lane viaduct and new tunnel under waterway	public	$5800 (planned), $14800 (outturn)
Post Office Square garage	Boston, USA	Underground car park with park on top	private	$80

Stadtbahn Dortmund site S10	Dortmund, Germany	Subway tunnel with stations	public	€200
Herren Tunnel	Lübeck, Germany	Tunnel under waterway	private	€179

Emergence of unmanageability

Our approach to studying manageability in projects has deviated from often seen performance analysis. In many cases such analysis is strongly event-related and assumes a strong link between managerial decisions and outcome. In our research (see also Leijten, 2017), we have taken as a point of departure that reduced manageability rarely results from events that create a crisis in one blow, but instead emerges gradually; with projects spiralling out of control. This extends from Whitty and Maylor's notion that project complexity does not only have a structural component – i.e. technical and organisational elements as individual components – but also a dynamic component; i.e. these components being subject to constant changes and, in addition, interacting with each other (Whitty and Maylor, 2009: 305). For this development of a project spiralling out of control we use the term "bounded manageability". In this concept the manageability of a project is related to three aspects:

- Monitorability. This is project managers' ability to keep track of events and measure performance. Monitorability implies that the manager overseeing a system understands the things that happen and can detect deviance.
- Predictability. This is project manager's ability to foresee the consequences of decisions, actions and emerging situations.
- Controllability: This is the ability of project managers to intervene, for instance in case of deviance. Do they have control over developments or can they take effective corrective actions?

Unmanageability occurs in any case where monitorability, predictability and/or controllability are affected to such an extent that performance is seriously influenced. As a concept, it is comparable to Whitty and Maylor's "dynamic uncertainty", which they distinguish from

"structural uncertainty" Although the focus is on the occurrence of potential unmanageability, this does not mean that all occurrence eventually led to a negative outcome. Some were managed in such a way that unmanageability did occur, but did not lead to performance issues. Since they all concern trade-offs where there was no full control over the outcome though, we speak of the occurrence of "bounded manageability". This implies that an event is merely a symptom of bounded manageability and that hence the origin of the event cannot be reduced to one single decision. Instead, we have therefore looked for the whole narrative behind performance defining events. In the same line of thought we did not look for decisions, but for trade-offs. This may seem a futile difference, but it is not. A trade-off reflects a dilemma. It assumes there is a variety of options with both upsides and downsides, which makes a "right choice" (or a "wrong choice" for that matter) less obvious than often assumed in a decision. We will discuss this further in the section "dilemmatic management options". A consequence is that we did not only follow the typical back-in-time-orientated, evaluating event-cause logic, which typically leads to one key-decision that explains the project outcome. Instead, we also tried to trace the forward-orientated logic from multiple trade-offs to eventual project performance that the managers were confronted with at the time they occurred. Next section explains why this is another important difference to often performed project studies.

Empirical research of bounded manageability and managers' trade-offs

We explored a total of 55 occurrences of manageability defining events in the six studied cases; ranging from unforeseen incidents in the construction, the emergence of earlier unknown constraints and conflicts to design trade-offs. It appears that many of the occurrences did not actually result from one clear trade-off. In many cases there was a series of trade-offs; with in some cases a path dependency between the trade-offs. In addition, many trade-offs were not part of a clear appraisal process, but instead happened unwittingly and

could only be identified in hindsight in the documentation studied and the interviews conducted. This is a result of the impossibility to use a rational decision-making model in the situations of uncertainty that were typical for the trade-offs (March and Simon, 1993). Instead, much of the decision-making in these situations is based on heuristics (Simon, 1977); also intuitive judgement (Hogarth, 1987); i.e. rules-of-thumb that are used unwittingly and that are often based on experiences or ecological conditions (Gigerenzer and Todd, 1999). In many organisational situations, this type of judgement and decision-making can be favourable (cf. Artinger et al., 2015), but in our empirical study, we also see some downsides; regularly related to difficulties that come with the involvement of multiple actors and the interests they bring into the project.

An example. In the studied Souterrain project (the tunnel part of RandstadRail), where a tram tunnel annex underground car park were built in the centre of the city of The Hague (the Netherlands), the excavation inundated during construction works. This was caused by a leakage that was the result of a whole series of engineering and contract management trade-offs. In chronological order:

1. The commissioner decided to add a two-storey underground car park to a fairly straight-forward tram tunnel it had planned to build; mainly to satisfy abutting real estate owners and tenants (mostly large department stores).
2. The commissioner hired an engineering company for the specialist job of designing the now complex subterranean structure, but selected it on the basis of its skills in managing a complex social environment.
3. A temporary strut had to keep the tunnel walls in their position during excavation while a separate gel injection layer should keep groundwater out of the excavation during construction. The commissioner and its design engineer considered whether

they could combine these two functions in one component: a strut in the form of a concrete layer. This would save money.

4. For the strut function it was best placed immediately under the maximum excavation depth, whereas for the groundwater function it was best placed deeper. Commissioner and design engineer decided in favour of a high strut, because this would reduce the necessary depth of the walls and hence save money.
5. The concrete strut remained a disputed element in the design. In the tender phase, candidates for the contract wanted the commissioner to provide its dimensions to maintain a level playing field. The commissioner perceived this as a first step to evade liability.
6. The contracting consortium that won, did not want to assume liability for the strut and called it an unreliable design. The commissioner decided to stick to it nevertheless, assuming this was, again, a tactic to evade liability rather than a sincere concern.

In each step the commissioner makes fundamental trade-offs on scope, time, cost and/or quality. In practice these trade-offs are, however, made on different levels in the hierarchy and under different circumstances related to the phase the project is in. As a result, parties on different hierarchical levels make decisions on different manageability levels. The highest hierarchical tiers are responsible for the high-level decisions, such as on scope and quality level, whereas lower hierarchical tiers have responsibility for everyday manageability issues that directly influence budget and time schedules. Moreover, the dilemmas on those different manageability levels typically occur in different phases of the project. Scope and quality are defined upfront, whereas the mentioned everyday decisions occur during project implementation. In step 1 of the chronology described above the managers involved were unaware of the trade-off they or their subordinates would face in step 6. One could probably even make a good case for the thesis that they were not even aware of the upcoming trade-off

in, say, step 3. Step 1 and 2, after all, were trade-offs on political level; the level where the project is defined. Ambitions are high, so attempts are made to maximise the scope and quality. Step 3, on the other hand, was an engineering trade-off; made by entirely different managers, in an entirely different tier of the organisation. Once arrived at step 6, the trade-off concerns operational issues, such as changes to an existing design and all the potential consequences, as well as the behaviour of other parties. These trade-offs are typically made with the impact on schedule and cost in mind. Meanwhile, the commissioner deals with the composition of the project organisation (step 2), the divergence of values and the way in which the gap between information availability and decision-making authority is bridged (steps 3, 4 and 5).

Table 2 shows the different levels and time frames of these trade-offs. The highest level is the project definition level, where strategic trade-offs on scope (functionality, size etc.) and quality are made and where a budget is allocated. Lowest in the hierarchy of trade-offs we find those on operational level. They relate to the daily complexities of working in an uncertain environment of changing circumstances and extreme dependencies on other parties carrying out part of the work. And then there is a level in-between, where tactical trade-offs are made on how the project organisation is set up to create the link between strategic policy and the reality of daily execution.

Table 2: Separation of dilemmas by the dimensions time and hierarchical level

Hierarchical level	Time		
	Early		*Late*
High	Project definition level dilemmas		
Middle		Organisational level dilemmas	
Low			Project execution level dilemmas

As mentioned, the sequence of steps shows interdependencies between the steps; in some cases even path dependency. The fact that trade-offs occur on different levels, within different

time frames and with diverging main focuses implies, though, that there is little coherence in the series of trade-off outcomes. Each trade-off is made in isolation, where the explicit and implicit conditions, constraints and path dependencies should be considered. Whereas an ambitious design, implying a high level of uncertainty, could be compensated through prudence in operation, projects now get trapped in patterns; always reaffirming the earlier set course. Symptoms can be found throughout the project; for instance in risk management. In the communication of risks between project manager and project owner, there tends to be a strong focus on operational risks (Krane et al, 2012). This way managers and engineers are caught in a dead spin; spiralling out of control.

Dilemmatic management options

Making trade-offs characterises the work of the project manager better than making decisions for various reasons. We earlier mentioned that it reflects better that there is no clear right or wrong. The reason for this is that many project management trade-offs have a "double bind" character. For every direction a project manager can take in a trade-off, there are disadvantages that level out the advantages. As a consequence, when there are dichotomic options in a single trade-off, it may not make a huge difference whether one goes left or right. But when one turns in the same direction in every trade-off, the project may get out of balance; as it leans too much to one or two values. If such a balance is absent, this can lead to the four project values scope, quality, time and cost getting out of balance too. In the above example, for instance, we see the commissioner maximising the scope first and after that opting consistently for the minimisation of cost, although by choosing for a challenging scope he evoked a higher level of uncertainty in the project. A minimisation of cost and a high level of ambition, and hence uncertainty, do not combine very well from a manageability point of view.

In the studied projects, a total of seven main, high-level trade-offs were identified on the three hierarchical levels earlier mentioned. In the remainder of this section we will discuss all seven trade-offs and the double bind that is typical for them.

On the project definition level, trade-offs in essence all relate to the level of uncertainty in the project. Conceptionally, this can be defined by the “uncertainty gap”, i.e. the gap between the level of knowledge and information necessary to bring the project to a good end, and the level of knowledge and information available in or to the project organisation (Galbraith, 1977). Although the outcome of these trade-offs relate to the configuration of the project organisation, the size of the gap is actually the result of the level of ambitions of the commissioner. The gap can be bridged by increasing the available knowledge and information or by decreasing the level of knowledge and information required; the latter typically by lowering ambitions. The latter would imply things such as choosing for a smaller scope or disentangling a project from a complex environment. Alternatively, a commissioner can choose to increase the knowledge and information available in or to the project organisation. This is often achieved by acquisition of knowledge and information from specialist firms. This strengthens the interdependencies between parties and leads to a further increase of uncertainty.

On the project organisation level we find three typical trade-offs. First, there is the level of segmentation in the project organisation. On the one hand, the acquisition of knowledge and information often implies an increase of the number of parties involved, as expertise is divided over many different specialists. Their involvement can be considered helpful. But on the other hand, the increase of involved parties implies more interdependencies and handovers, and hence more complexity in the project organisation and more uncertainty in the execution of their tasks and their attitude and behaviour in the project. With fewer parties

there will be fewer handovers and less dependency, but the same level of specialism cannot be achieved. There is a clear relation with the previous dilemma.

A next step would be to consider the level of divergence of values within the project organisation. The inclusion of competing values in the project organisation can create a balance in the pursuit of scope, quality, time and cost, as different parties pursue different values. But this divergence also means complexity, and uncertainty for the commissioner on how individual parties will behave. The interrelatedness with the segmentation dilemma is obvious.

The third trade-off on project organisational level concerns the typical gap between information availability and decision-making authority. In most project organisations the ultimate decision-making authority does not lie with the parties who have most knowledge (such as hired experts) or information (e.g. contractors with constant input from the work floor). This marks a typical principal-agent problem, leading to 'vertical uncertainty' (Jensen, 2004: 6-7) in the project organisation. "Agents" (contracted parties/the work floor) carry out work on behalf of the "principal" (commissioner). These agents have more specialist knowledge, but the principal makes the decisions. The manager can decide to keep the two sides of the divide disentangled, with the risk that information will be selected and "coloured" by the agents or that the interpretation by the principal is flawed. Alternatively, principal and agents can get intertwined to make sure the principal keeps a clear view on the production and exchange of information, but with the downside that it can make the agents very powerful, as it brings them very close to the decision-making. One of the ways to achieve this would even be passing some of the decision-making authority to the agent(s). Again, one can see a clear relation with the previous dilemma, as the principal-agent problem is in essence a value variety problem.

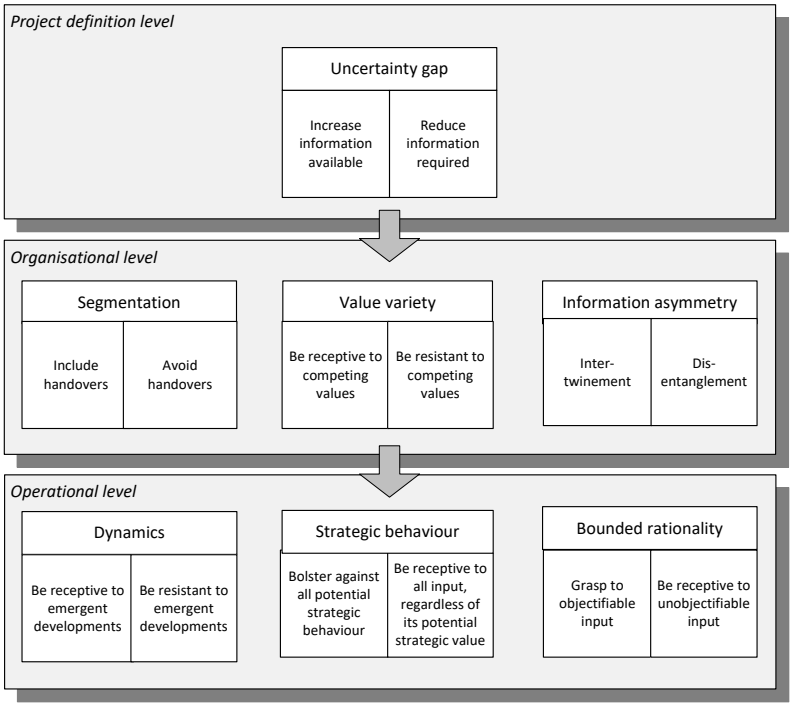
Then, there are three typical trade-offs that cover the essence of the most impactful dilemmas in the implementation of projects; the lowest level in the hierarchy of the project. First there is the generic trade-off on what to do with dynamics; i.e. any deviation from the original plans that could have an impact on scope, quality, time schedule and cost of the project. Some changes are mandatory, such as changing regulatory requirements, but many are a matter of choice, such as introduction of a newly available technology halfway through the project, adjustment to changing demands etcetera. Change can be embraced as an enrichment of the project, or fended off as a threat to the stability of schedules and budgets.

There are also trade-offs related to the attitude of individual parties in the project. In each decision they take, request they make and information they exchange, they will consider not only the project interest, but also their own interests (cf. Laffont and Martimort, 2002), creating 'moral uncertainty' (Tannert et al., 2007). This marks the typical principal-agent problem in the above described relationship between decision-maker and information provider (Jensen and Meckling, 1976), so this is a clear follow-up on the information asymmetry dilemma. Two typical problems can arise in such a situation:

- Adverse selection. The commissioner does not know all the motives for potential contractors to bid in a tender and may therefore pick the wrong one. A contractor may for instance bid low, which makes him attractive, but he may do so because he cannot get jobs, perhaps because he often does a poor job. Moreover, he will also be the candidate who will be most eager to claim additional work and costs, since as a result of his lowest bid, he has the largest loss to compensate.
- Moral hazard. Agents partly pursue their own interests, which may deviate from the principal's. Contractors have an incentive to make the largest possible profit in a project, whereas the commissioner wants to spend the least possible. There is also a clear incentive for parties to evade liability.

The question then is whether the project manager, being aware of the multiple interests, will fend off input that could be strategically "contaminated" or whether he/she should be receptive to such input. In conjunction with this, the project manager can trade off what to do specifically with occurrences of unobjectifiability in exchange of information or requests. Should everything taken into account, such as scope requirements, requests for changes and additional work etcetera be objectifiable (quantifiable, measurable, accompanied by proof) or not? What to do for instance with hunch feelings and heuristics-based judgements?

This all then results in the overview in picture 1.



Picture 1: Overview of trade-offs in different levels of project management (Leijten, 2018: 243).

As could be seen in the foregoing description of dilemmas, interrelations can be seen between them. This eventually leads to the mentioned patterns of dilemmas. For example, inclusion of many parties and hence handovers in combination with a large variety of values implies that lots of specialist information flows will be generated, possibly from parties with strongly

diverging values. Due to the strong diversity and segmentation, there is no clear dominant party, which means the commissioner will probably keep the parties disentangled and he himself will stay in a leader position, keeping control over decision-making. In practice this may precondition managers on operational level. To make sure the information on the basis of which the commissioner makes decisions is reliable, they may have strong reservations against any input that could be influenced for strategic reasons.

Breaking the patterns; towards a new path dependency

In this section we will make suggestions that can help the project manager towards higher manageability in this web of dilemmas. To achieve this we concentrate on approaches that will help to bring more coherence in the consideration of trade-offs. We are not going to be complete; the above overview results in 128 possible combinations of trade-off outcomes, and only if we reduce the real rich choices of project managers (like on getting to an appropriate scope definition) to simplified dilemmas (like simplify the scope or get more information on the scope) we can show rough tendencies. So, project managers in reality have a far wider choice set, which can be conceptualised in the dilemmas described above.

From the cases we recognised three ways in which project managers can deal with the complexity, that could help making trade-offs in coherence. The three approaches seem to be complementary in the projects.

- ***Early alternating between scope + quality and time + cost***. We saw a tendency for decision-makers high up in the hierarchy to focus mainly on a maximisation of scope and quality. They do allocate a budget and determine a time frame, but rarely consider the challenge level and hence the level of uncertainty they create by their (often politically motivated) ambitions and what implications this will have later on during implementation on a lower tier of the hierarchy. Although it is difficult for them to

foresee the detailed trade-offs that have to be made during implementation, they can be aware of the fact that trade-offs on dynamics, strategic behaviour and unobjectifiability in general will occur. The challenge this will impose on the manager during implementation can be influenced by the level of uncertainty allowed in the project and should therefore be take into account on the basis of parameters that can provide lead information. A good parameter here is the number of interfaces, both in technical and social/organisational systems, both internally and externally oriented and both vertical (within hierarchical systems/organisations) and horizontal (between systems and organisations).

- ***Alternating between predict-and-control and prepare-and-commit***. The project showed project managers being focused on controlling planning, schedules, costs to the budget, progress etc. and on predicting how the project will proceed and estimating the outturn cost and completion date. Such an approach is indispensable but cannot provide the flexibility required to adjust to emerging and unforeseen developments that are the result of the uncertainty that is inevitable for complex projects. In the dilemmas, the choices could be combined to traditional project management, aiming to realise high complexity challenges through phased and compartmentalized controlled information flow and performance monitoring in hierarchies, what we will call predict-and-control. Or the dilemmas could go towards more open and shared information exchange and performance commitment in processes, what we will call prepare-and-commit. In their absolute form, both are problematic. The project manager should therefore alternate his/her predict-and-control approach with a prepare-and commit approach (see also Koppenjan et al., 2011)
- Process arrangements. There are a few process arrangements that can steer the behaviour of parties in a project organisation setting and that can be applied in each

phase of the project and on every hierarchical level. They can for instance be aimed at disciplining the contracted parties, as well as the commissioner himself. The former can for instance be achieved by inclusion of incentives to prioritise the project value over own values. The most well-known way to achieve this is with incentive contracts. For the latter, a commissioner can for instance organise countervailing powers in the project organisation; a party with an independent assurance task with a clear mandate. Project managers can also take away some uncertainty by pre-configuring process actions in the style of: if during the project X happens, we will respond by doing Y. This will make the organisational environment more predictable. There are always downsides to these arrangements. Parties may for instance adjust their behaviour mainly to pass assurance tests or to achieve certain pre-configured actions, but there are sufficient examples where these arrangements at least have some effect. In the oil and gas industry, independent assurance is, for example, widespread, whereas in the construction industry it is at many places still rare.

Conclusions

This leads to the finding that many occurrences of unmanageability cannot always be successfully prevented by applying the typical project management mechanisms. Certain response mechanisms have, mostly unwittingly taken root in the actions of project managers. The control focus, for instance, appears to be stronger the lower one gets in the hierarchy. In the higher echelons ambitions frequently balloon the levels of uncertainty faced by the project organisation and the executers.

This implies that sponsors, who mostly act on the typically abstract definition level – usually early-on-in-the-project – should not be predominantly led by their ambitions, but also by the level of uncertainty they evoke and the demand for control in execution. Likewise, on the low-in-the-hierarchy and late-on-the-timescale execution level, control-focussed managers

should not lose sight of the functional requirements that are produced by a hopefully thorough requirements management process. Both should consider the trade-offs they make in the coherence of the whole project. The configuration of the project organisation – in the middle of the two – is pivotal in this. It offers opportunities to organise the right incentives, countervailing powers and process arrangements to steer managers on each level to a project-wide optimum.

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