Manageability of Complex Construction Engineering Projects: 
Dealing with Uncertainty

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Abstract

Complex underground construction projects appear to suffer from high levels of unmanageability caused by the gap between the information required to build the systems and the information available to the decision-makers. Many project managers attempt to address this problem by increasing the information available to them, often using input from hired stakeholders. Two example projects, Boston’s Central Artery/Tunnel Project and The Hague’s Souterrain, show that this strategy can cause even more uncertainty than it solves. The information providers may provide the information with strategic values in mind and the decision-makers may misinterpret the information due to an overemphasis on objectifiable, quantifiable information and criteria, while disregarding less tangible potential causes of deviance. The solution may be found by reconsidering the incentives in the project organization.

Keywords: engineering systems, uncertainty, information

1. Introduction

Complex construction engineering projects are regularly plagued with manageability problems. To the outsider, this results primarily in frequent delays and cost overruns, a topic that has been extensively studied by such authors as Wachs [1], [2] and Flyvbjerg et al. [3], [4], [5], [6], [7]. Every now and then, we are also confronted with accidents that occur as a result of technical flaws. Recent events that received extensive media coverage in the United States and Europe, respectively, include the ‘Big Dig’ ceiling collapse in Boston (2005) and the Cologne subway/historical archive collapse (2009), which both involved casualties. The two phenomena are not unrelated, since many overruns are the result of unexpected events during the installation of the complex technical systems within construction engineering projects. The track record shows that underground projects in particular encounter manageability problems. This may be because more unexpected events take place in these

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projects than in other projects, or because the consequences of these events are more serious, or both.

This paper sets out to show why technical complexity and uncertainty can still trouble project clients and why, despite extensive and ever growing technical expertise, the unmanageability of projects still constitutes a valid – though highly undesirable – reason for mishaps. Section 2 will explain why uncertainty and unmanageability occur – and will continue to occur – in the first place. Section 3 will then present two cases in which such unmanageability occurred in practice. The cases selected are the Central Artery/Tunnel Project in Boston, Massachusetts (United States) and the Souterrain project in The Hague (the Netherlands). Both projects included cutting edge technology and complex implementation trajectories, but also contractors that were expected to be able to manage this. Both experienced failure, however, and ended up with serious cost overruns and the former even with one fatal casualty. Section 4 will then explain, on the basis of the findings from the cases, why project organizations are often still unable to deal effectively with inherent uncertainties. Section 5 will discuss possible solutions.

2. Unmanageability and uncertainty

2.A. Why Increasing Knowledge does not Exclude Unmanageability

Our knowledge of the technology used in complex projects grows. We have also developed many methods to increase the manageability of projects and their planning (such as the Critical Path Method and Work Breakdown Structures). This could lead us to believe that we are becoming increasingly successful in managing complex projects. However, as Flyvbjerg et al. point out, we must acknowledge that the track record of complex infrastructure project management has not improved. Cost overruns and delays are, on average, just as large as they used to be [3], [4], [5], [6], [7].

Although techniques for managing complex projects are improving, the challenges faced by managers also continue to grow. New technologies are being developed to enable better or cheaper projects, but these new technologies start unproven, just as now well-known technologies were also once untested. Even existing technologies are regularly applied under new circumstances and conditions. Although managers and engineers gain experience each time a given technology is used, the circumstances and conditions of each new project are often unique. Despite Flyvbjerg et al.’s analyses, the managers and engineers involved in complex infrastructure projects often fail to include sufficient buffers for these uncertainties. This means that there is little room for deviation and the project performs inadequately not only in technical terms, but also managerially, as a result of technical difficulties.

2.B. The Uncertainty Gap

Unmanageability comes about through uncertainty. Galbraith [8] introduced the concept of the “uncertainty gap”. He defines uncertainty as the gap between the information required to build a technical system and the information available in the project organization to do so. There are two sources of this uncertainty related to information (see also [9]):

- Complexity. Galbraith uses the term for the situations in which information is theoretically available, but is too costly or time-consuming to collect and analyze.
- Unpredictability. The condition where the past is not a reliable guide to the future. Although the future is by definition unknowable, past experience is expected to be a valuable guide to the future in many situations.
Underground construction projects are among the most vulnerable engineering projects and generally have large uncertainty gaps for a number of reasons:

- They contain a wide variety of system elements, often with many interfaces and interdependencies [10];
- They require (also for that reason) a high degree of specialist engineering expertise from the actors involved;
- They are often implemented in view of the public and individuals can experience the effects of this.

3. Two case studies

To explore how unmanageability works and why it is a persistent problem, two example cases will be presented in which unmanageability was experienced to a certain extent throughout their implementation.

3.A. The Central Artery/Tunnel Project

The Central Artery/Tunnel Project (also known as the ‘Big Dig’) was a scheme to rebuild Boston’s elevated Central Artery expressway, which cut through the city center, in order to eliminate this disturbing element and relieve the persistent traffic problems in the center of the city. The expressway has been replaced with an underground road. The project was too extensive to describe all the details here. It was basically composed of many subprojects: a downtown tunnel, a connecting cable-stayed bridge, two consecutive tunnels under the harbor to the airport and many additional subsidiary sections. The tunnels had to weave between many existing structures, both above and below ground. It took about fifteen years to build all the sections, demolish the old structure and restore the surface, predominantly with parks.

Prior to the start of construction, the project client – Massachusetts’ Department of Public Works on behalf of the Commonwealth of Massachusetts (owner) – had been downsized and was not equipped to manage the whole project by itself. The Department therefore hired a large project management joint venture as a consultant to draw up preliminary designs and oversee implementation. This structure meant that the management consultant was to supervise the contractors and designers, while the Department of Public Works was to oversee the project management consultant. The size and internal variety of the project’s technical system resulted in 38 different section design consultants and 142 construction contracts [11], [12].

During the work, subcontractors filed a large number of claims and changes with the project management. In many contract areas, deviate site conditions occurred and during implementation many minor design changes had to be made that led to changes in contracts. All these claims and changes piled up at the project management’s office. Many of these necessary changes are said to have been the result of flawed designs by the management consultant. However, because the management of the Department of Public Works did not have the same level of expertise as the management consultant, the Department depended heavily on the consultants and could not make independent assessments of whether the numerous claims for changes resulted from flawed work or were simply an unavoidable effect.

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2 This section is based on research executed by the author, which included a study of relevant documents and interviews with stakeholders.
of building a very complex technical structure in a densely built-up landfill area while the old structure that had to remain open during the work.\(^3\)

In the meantime, costs escalated massively during construction. This was partly caused by inflation, but also by the numerous changes made. The mounting cost overruns and awkward decision-making processes encouraged the project owner to reconsider its project organization. The owner established an Integrated Project Organization (IPO). Previously, many positions had been held by employees of both his client organization and the management consultant. Under the IPO, however, the most qualified person would remain and the redundant position was scrapped. In this way, the two organizations were integrated. The owner hoped to move the managers of the client organization closer to the information resources, but in practice this impeded oversight even further. It saved on costs but also removed the checks and balances within the project organization. Considering that the hired project management consultant was paid on a cost-plus-fee basis, its interests did not always correspond to those of the owner. As a result, it has been difficult, if not impossible, to assess whether the hired project managers did a good job.

After the new system had been opened, some serious flaws were revealed. The tunnel under the downtown area was riddled with leaks requiring extensive repairs which may need to continue indefinitely. In addition to the use of inferior concrete, for which one supplier was prosecuted, the interfaces between several subsystems, such as that between slurry wall panels and between the slurry walls and the ceiling, also proved vulnerable. Moreover, a drop-ceiling in the connector tunnel on the I-90 route between downtown and the harbor tunnel collapsed, crushing a car and killing one passenger. The design for these drop-ceilings had been changed during the construction work because they were found to be vulnerable to strong vibrations. The new ceilings were heavier, but the outer tunnel shell to which they had to be riveted did not include steel beams capable of bearing heavy loads. According to the specifications, the chosen bolt-and-epoxy fixture should have been capable of bearing the weight, but this fixture required a very careful installation process. The work process had become much more vulnerable to failure. Although the cause of the incident has not been established unequivocally, forensic research has led to the conclusion that unrecorded deviance during the installation process probably caused the fixtures to give way.

3.B. The Souterrain Project

The Souterrain is a three-storey underground structure in the center of The Hague, consisting of a tram tunnel (lowest storey) and a two-storey underground car park. The Municipality of The Hague was the owner of the project. It established a project client organization within its own City Management Department. Because of its lack of skills and experience in tunneling, it hired a private engineering design firm that would also oversee (as a project director) the implementation of its design by a private contractor.

During the procurement phase, the preferred bidder for the construction job questioned a part of the design that would seal-off the construction pit against groundwater during the construction works. An external consultant had also advised against this plan earlier. This design, an arch-shaped layer of jet-grout columns, was relatively unproven and had, for cost reasons, been designed with a bare minimum level of redundancy. Neither the contractor, nor the insurance company wanted to accept liability for this part of the design. The engineering designer, however, stood by the design. This put the Municipality in an awkward position, as

it did not know how to evaluate the advice of the contractor and the insurance company. Were they sincere or were they acting strategically in order to avoid liability for any possible risk? The contractor had made a surprisingly low bid in order to win the tender, which was an additional reason for the client to be suspicious about change requests that might result in additional work. The Municipality, which did not have the expertise to assess the technology itself, stood by the engineering designer and decided to proceed with the designs as they stood. The contractor did not block this process as it could now waive liability for the design and the project was very important for them.

Subsequently, a risk analysis produced by the engineering designer caused friction between the engineering designer and the contractor. Failure of the seal was likely to cause an irrevocable collapse. The designer compensated for this risk by including wide safety margins in the specifications. As long as the contractor respected those margins, implementation was considered safe. The work on this subsystem did, however, have to take place some fifteen meters below ground level with an injection lance that would deliver significantly different results if not injected exactly vertically into the ground. The contractor considered such a risky technology irresponsible, despite the safety margins. A reason for this opinion was that the contractor’s success in complying with the specifications turned out to be the pivot of liability.

Approximately two years after the start of the implementation, the tunnel construction site flooded as a result of a breach in the seal. The project director blamed the contractor for not working in accordance with the specifications, while the contractor reposted by stating that any technique that included such an inherent risk of failure should not have been chosen. In the subsequent search for a way of finishing the work, the contractor played hardball, refused to trust the designer any longer and, after threatening to withdraw, was allowed to finish the project using its own design and – more expensive – technology.

### 4. Constraints in closing the uncertainty gap

#### 4.A. Information Asymmetry and Strategic Behavior

Both of these projects included a considerable uncertainty gap as a result of the use of sharp-edge, innovative technology in combination with clients with limited expertise in tunnel construction. Galbraith [8] mentions three methods of closing the uncertainty gap:

- Increase the information available in the project organization;
- Decrease the information required for successful implementation;
- Improve information processing.

The latter will not be discussed in this paper as it concerns project management techniques that are on a different conceptual level and, although valuable, cannot exclude some of the unmanageability features described in this article. Managers of both the CA/T and Souterrain projects attempted to close the uncertainty gap by increasing the information available. This is the most commonly used alternative, since decreasing the information required would imply a scaling down of ambition and/or accepting cost and time extensions. This increase in information was achieved predominantly through the use of consultants, engineering designers and construction contractors. These attempts did not, however, result in complete manageability. It could be said that they even caused more uncertainty. Closing the uncertainty gap by increasing the information available means that the decision-maker is more dependent on the information providers.
In Boston’s Central Artery/Tunnel Project, the client relied predominantly on the hired project manager, a strategy that disregarded the conflicting ambitions that this project manager had within the project (such as maximizing profit). The Integrated Project Organization even exacerbated this situation as it made the client depend even more on the hired manager, granting it more power still. This resulted in what the Inspector General of Massachusetts called an “accountability nightmare”.  

In the case of the Souterrain, the project client, having decided on the engineering design to be tendered, did not know whether the concerns expressed by the contractor and the insurance company were genuine, or just a way of guarding against possible future liability claims. As the client did not have the expertise to assess the reliability of the engineering designs itself, other considerations, which could be objectively assessed, came into play. Such considerations included cost constraints that excluded a more robust design and the enormous delay to the project that a fundamental design change would involve.

Because contractors and other hired parties own the required information and their interests within the project also diverge from those of the owner (for example, the profit motive), they have an incentive to provide strategic information that drives the decision-maker to solutions that are primarily attractive for these profit-seekers. This results in a dilemma for the client as to whether he should treat all input from actors with different interests skeptically, accepting the risk of making decisions that may lead to flaws, or be vigilant and accept all input to maximize the chance of safe decisions, with the risk of being trapped by strategic behavior.

As mentioned, the utility of the client and contracted actors differs. Both are utility-maximizers, meaning that their interests diverge. Hence, the availability of information regarding a project does not automatically mean that it is also available to the client as the main decision-maker. From the client’s perspective, this means that information is ‘blind’ – that is to say, it is known to one or more of the actors in the organization, but not to the actor with the power of decision [14]. This confronts the client with a principal-agent problem: he cannot oversee the trade-offs that information owners, such as contractors, engineering designers and insurance companies, make in their implementation efforts [15], [16], [17].

As a result of the principal-agent problem, the availability of information regarding the project is not always the solution to uncertainty. Blind information in combination with strategic behavior (as a result of a difference in utility) can be even more hazardous than ‘unknown’ information (information that is not available to any of the involved actors), even though in the former case there is at least one actor with the required information and in the latter there is none. In the latter case, proportions are equal – that is to say, both principal and agent are equally handicapped. This may provide them with a common incentive and, importantly, cause them to exercise greater vigilance. In a situation of blind information, on the other hand, the principal may be fooled by the belief that he is safe due to the knowledge of his agent; in a situation of unknown information, meanwhile, the principal is aware of the shortcomings of the project organization.

Summarizing, this method of closing this gap have important constraints:

- Information may be available within the project organization, but not to the decision-maker. This phenomenon is also known as information asymmetry.

4 Letter from Inspector General Cerasoli to Massachusetts Turnpike Authority chairman Andrew Natsios, May 3, 2000; Commonwealth of Massachusetts, Senate Committee on Post Audit and Oversight, Road blocks to cost recovery; Key findings and recommendations on the Big Dig cost recovery process, December 2004.
Even the availability of information is no guarantee of optimal decision-making because the decision-making client cannot be sure of the motives of the information providers.

4.B. Preoccupations and Flawed Interpretation
A second problem is that clients may not be able to interpret information that becomes available correctly, being less capable of assessing the information properly than the information providers. They may also allow their own values to prevail, which does not necessarily provide the best trade-off between the project management benchmarks – time, cost, scope and quality. If clients indeed decide to close the uncertainty gap by increasing the information available, they may try to compensate for the negative effects by, for example, attempting to anticipate strategic behavior. As they cannot do this rationally due to the limited information they have, undesirable effects are possible that can significantly affect specific decisions. This subject will be addressed in the following section.

Both the CA/T and Souterrain projects provide us with examples of concrete decisions on complex technical issues that show client decision-making in a limited rationality situation. In the CA/T Project, project managers insisted on a redesign of the concrete drop-ceiling slabs, despite the doubts of engineers, as the bolt-and-epoxy fixtures were, according to their (objective) specifications, supposed to hold. The use of these concrete slabs was the most favorable, contractually, but with hindsight it appeared that the work process of installing the drop-ceilings included so many potential points of deviance (which were difficult to objectify in advance) that the real risk was in fact much larger. Likewise, the managers of the Souterrain project insisted on their jet-grout seal design, despite the doubts of the contractor, the insurance company and an external specialist consultant. A change would have made the design more expensive and the client was strongly preoccupied with keeping the project within budget margins and time schedules. According to standard specifications of the technologies used, the margins of the columns were, viewed objectively, sufficient.

Both the technical trade-offs on the bolt-and-epoxy fixture in the CA/T Project and the grout arch in the Souterrain project appeared to lead to a high level of unmanageability, as the unexpected mishaps have since proven. This unmanageability was reinforced by the repetitive work process which meant that the chance that at least one element would fail was actually fairly high. The bolt-and-epoxy fixtures of the CA/T Project (there were hundreds of bolt fixtures in the tunnel) are an example. Similarly, in the Souterrain project, the standard safety margins were large, but with the repetitive production of 8,000 columns at 15 meters deep, the chance of one of them leaving a fatal void was considerable (in hindsight, this was quantified at five likely anomalies).

In the above situations, two different kinds of risks can be distinguished. This distinction is based on the different risks identified in enforcement situations by De Bruijn and Ten Heuvelhof [18]:

- **Damage risk.** This is the static risk that the use of a technology might fail for reasons inherent to that technology. Usually, technologies have an acceptable risk of failure (for instances indicated as one failure in x years). Such figures objectify trade-offs and other considerations
- **Deviance risk.** This is the risk that, even when a technology complies with predefined standards, failure can occur during application.
Damage risks are managed by checking plans and designs against predefined standards. They can be established relatively objectively and quantitatively. Flawed application increases the chance of failure as determined on the basis of these damage risks, but is nevertheless often disregarded as an important risk contributor. Project managers are often preoccupied with risks that can be defined objectively. Deviance risks depend on the skills and meticulousness of the implementer, which is difficult to establish objectively and, more especially, to determine in advance. Informed actors, such as contractors, are generally aware of these implicit deviance risks, while clients generally have less feeling for them.

So, in the case of blind information, rational decision-making is no longer possible. Clients, however, are often inclined to make decisions rationally anyway. Decision-makers (here the clients) have reason to frame the information that they receive from information owners such as contractors and other engineers. Given the limited information they have in comparison to information owners, they are likely to be preoccupied with aspects that they can understand and that they can explain or defend. As the cases show, this can influence their considerations in two ways:

- Client-related decision-makers are inclined to stick to objective, quantifiable and measurable information, aspects and criteria.
- Client-related decision-makers are inclined to insist on aspects that limit the time and costs involved in implementing the project, as they are politically assessed on their management of these values, while other benchmarks such as quality and safety require different information that is normally unavailable to contracted actors and include implicit manageability mechanisms that are much less visible.

In practice, many important aspects in project implementation that have a strong impact on manageability do not comply with the basic benchmarks that clients tend to pursue.

5. Possible solutions

It appears that the most commonly used strategies to deal with the uncertainty gap do not provide the desired manageability. In this section, three possible alternatives will be discussed: an increase in the expertise of the client organization, outsourcing and adjusting ambitions.

5.A. Increase in the Expertise of the Client Organization

The information provided on the two cases shows a common problem that applies to both the client of the Central Artery/Tunnel Project and the Souterrain project, and in fact to many owners or clients of complex technical projects. It concerns the lack of expertise of the client organization. Not only are they unable to design and implement projects themselves, they are also unable to oversee the works and assess complex technical issues effectively. This means that they easily become the victims of intentional or unintentional influences from other stakeholders.

The most natural alternative would be to increase the expertise of the principal, rather than just relying on the expertise of agents. In practice, this is difficult to achieve. Many public engineering organizations have seen their staff numbers reduced over recent decades. This also applies to the clients of the Central Artery/Tunnel and Souterrain projects. In the case of the Central Artery/Tunnel Project, this can be related to the end of the era of mega-projects [13]; in the case of the Souterrain project, it can be related to privatization initiatives in Dutch public institutions. Due to a strong emphasis on public efficiency, it is unlikely that any
reverse in this development can be expected. Moreover, if decentralized authorities become responsible for large and complex infrastructure (as has happened in the Netherlands), it is unlikely that they will initiate a sufficient number of projects to employ a large engineering department with specialist engineers. If a range of consecutive projects are to be expected, establishing such a department may be a good way to bypass the principal-agent problems that plague many other projects. Some German cities which began long-term subway construction schemes a few decades ago have executed relatively manageable projects (although the Cologne subway collapse, probably a result of ‘deviance risk’, raises awareness that even those clients are not immune to unforeseen events). A cheaper approach would be to install a small committee of specialist engineers that can assess the main technical trade-offs. Some German cities which began long-term subway construction schemes a few decades ago have executed relatively manageable projects (although the Cologne subway collapse, probably a result of ‘deviance risk’, raises awareness that even those clients are not immune to unforeseen events). A cheaper approach would be to install a small committee of specialist engineers that can assess the main technical trade-offs. Some German cities which began long-term subway construction schemes a few decades ago have executed relatively manageable projects (although the Cologne subway collapse, probably a result of ‘deviance risk’, raises awareness that even those clients are not immune to unforeseen events). A cheaper approach would be to install a small committee of specialist engineers that can assess the main technical trade-offs. Some German cities which began long-term subway construction schemes a few decades ago have executed relatively manageable projects (although the Cologne subway collapse, probably a result of ‘deviance risk’, raises awareness that even those clients are not immune to unforeseen events). A cheaper approach would be to install a small committee of specialist engineers that can assess the main technical trade-offs.

5.B. Outsourcing

The principal-agent problem in the management of complex infrastructure projects can be characterized as the separation of information and decision-making competences on the basis of this information. Increasing the expertise available in the client organization would solve that problem by moving information to the decision-maker, but an alternative would be to shift decision-making authority towards the information owner(s). Because the information owners are mostly private parties, usually hired to provide their expertise, this would require the ‘privatization’ of decision-making. This is only acceptable if the private decision-maker also takes responsibility for the risks associated with the decisions made. The result is a form of outsourcing. An additional advantage would be that the private actors (such as contractors) would have an incentive to block any trade-off outcome that could be harmful. They would no longer be prepared, as in the Souterrain case, to implement a risky design provided they could fend off liability. Successful outsourcing has taken place in such projects as the German Warnow and Herren Tunnels in Rostock and Lübeck respectively, and in the Post Office Square reconstruction in Boston (in the latter project, even the initiative was private and it therefore went beyond simple outsourcing).

The acceptance of risk liability by private actors usually requires financial participation in the project and financial participation requires a way to earn back the investment. This means that private actors should have an interest in the profitability of the project. That is where one of the most important downsides of this model lies. Many projects do not allow for the privatization of operation once the system is part of a public transportation scheme, for example. Moreover, private actors may only be willing to invest in the most favorable projects, while the riskier projects will probably attract less favorable bids or contractors, although they may be just as necessary.

There are also intermediate forms of outsourcing, such as the form in which the client and the contractor share the responsibility for (the consequences of) risks and uncertainties. As Müller and Turner have shown [17], the more ‘traditional’ fixed price and cost-plus contracts have an adverse effect on principal-agent communication. The alliance model, in which clients and contractors jointly put the project’s largest risks in an alliance with joint liability, provides the client with proper incentives to be vigilant when accepting technical risk and the contractor with incentives to block doubtful trade-off outcomes. Further development of this model may be worthwhile.
5.C. Adjust Ambitions

If increasing the information available in the ways described above fails, the most logical alternative would be the other method of closing Galbraith’s uncertainty gap: decrease the information required. In practice that would mean adjusting (probably decreasing) ambitions. Another option would be to increase robustness, which usually has a negative effect on the project’s finances. If the available budget does not allow for sufficient certainty on the robustness of the design, either the budget should be extended or the scope (functionality) of the system should be scaled down. The same applies to project schedules. In practice, both options are often politically unacceptable and more uncertainty is implicitly accepted in order for the project possible to be realized.

5.D. General Observation: Reconsideration of Incentives

The above sections have shown that in most projects there is no simple way of closing the uncertainty gap. Increasing the principal’s own (as opposed to hired) expertise and reducing ambitions can both be effective ways to close the gap, but they are likely to cause political resistance. Outsourcing can also be effective, but is impossible or would have adverse tendering effects in many cases. All three solutions have one important feature in common and that is that they change the incentives of parties other than the client in such a way that their divergent interests no longer cause unmanageability from the client’s point of view. If the solution is to be found in traditional contracting, the most important prerequisite would be to get the incentives right.

How can this be achieved? If information providers do not have an interest in the end-result or in the finances of the project, the only way to provide them with the proper incentives to pursue optimization is to provide countervailing power through checks and balances. If assessors are permanently present in the organization, the information providers no longer have a monopoly on information. It is important that these assessors have an interest in providing a counterweight and so, their interest should not be the same as the contractors’ interest. An independent review committee in the principal’s organization could provide this.

6. Conclusions

Uncertainty drives decision-makers in complex underground construction projects towards objectifiable, measurable goals to be achieved with trade-offs based on objectifiable, quantifiable information. Ambitious construction engineering projects are, however, so complex that not all benchmarks and information can be established quantitatively and objectively. This problem is particularly crucial because clients are inclined to tackle uncertainty in their projects by trying to increase the information available, rather than decreasing the information required by scaling down ambitions or extending budgets and implementation time.

The solutions to this problem require a reconsideration of the incentives in the project organization. This should either shift decision-making (and most responsibilities) to the information owners, or shift information to the decision-makers, with, in the latter case, the proviso that this information be kept separate from the information of other stakeholders with divergent interests and from the pursuit of particular benchmarks. Despite the political inconvenience, the downscaling of ambitions by increasing robustness, reducing functionality, extending budgets and/or extending time schedules might deserve some more credit, as it may have the largest chance of success.
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