



The Royal Academy
of Engineering

Engineering and the Spending Review 2010:

Report of a round table meeting held at the request of Department for Transport

August 2010

Introduction

A round table meeting of Academy Fellows was held under the Chatham House Rule at The Royal Academy of Engineering on 19 July 2010. The Academy was asked to hold the meeting in order to explore how the engineering profession can help ensure that spending cuts focus on delivering value for money and have minimal impact on the delivery of public services and the maintenance of assets. Reducing engineering costs is a complex, risky but potentially valuable activity. The potential consequences of a mistake would either result in backing away from sensible discussion of spending on engineering because the consequences are seen as too risky, or unsophisticated cutting of engineering spending with no understanding of the consequent risks.

A need within Government for a better understanding of engineering issues across all sectors of policy delivery was identified.

This report details the output of the meeting, gathering related parts of the discussion together and, where useful, supplementing it through follow on discussions with the meeting participants.

The opinions expressed in this document represent the views of the meeting participants and do not necessarily represent the considered position of The Royal Academy of Engineering. They have been approved for publication by the Academy's Engineering Policy Committee and therefore are considered by the Academy to be an accurate reflection of the discussion of a specially convened group of Academy Fellows addressing specific questions.

Structure of report

In this report we consider:

- general issues of value for money from engineering projects and where projects and services can still be delivered under spending pressure;
- engineering methods that can help deliver better value for money, including where the engineering profession can add value.

Stewardship of assets and audit of assets

The meeting quickly came to the conclusion that public assets that exist for the purpose of delivering a public service needed to be held in stewardship. In a large number of cases, historical and present day, it could be demonstrated that the condition and value of those assets was not fully understood by those in charge of them or even known.

The value of these public assets is not simply the capital value or the cost of replacement, but the must include the value of the service that they provide or enable. Over the years, it was thought that Government had become relatively adept at understanding capital expenditure on national infrastructure but still fails to adequately audit, monitor or maintain assets between bouts of heavy capital expenditure and renewal.

The lack of understanding of asset value has also led to a lack of technical skills and knowledge (as opposed to technical research) to ensure that assets are maintained and able to deliver the services they are designed to deliver in the long term. There is a need to plan for the maintenance and upkeep of assets to the same level that that capital expenditure is planned and analysed. In refocusing engineering spending and effort towards asset maintenance rather than capital expenditure, an emphasis on quality was urged – a focus on quality drives down costs; a focus on costs drives down quality.

There is also a potential lack of understanding concerning the interconnectedness of elements of national infrastructure. This interconnectedness leads to knock-on effects from the failure of one asset to another, most easily illustrated by the transfer of passenger traffic from air to road and rail during the recent closure of airspace over Northern Europe due to the eruption of Eyjafjallajökull in early 2010. Understanding interconnectedness could also lead to obtaining better value for money from the public purse in the case of capital expenditure and avoiding expensive consequences of relatively insignificant spending cuts. For example, achieving cuts in flood protection can have implications for ground water levels which can lead to slumps in road and rail embankments and costs to those sectors that dwarf the original savings.

Capital expenditure can be planned and accounted for easily within the current accounting processes used by government. A focus on stewardship of assets with a full life-cycle approach does not currently fit well. The cost advantages of asset stewardship therefore cannot be adequately shown on the government balance sheets. Engineering companies routinely invest with a 20 to 30 year timeframe considering not only the capital expenditure on a particular asset but the operation and maintenance of it over its economic lifetime (and often beyond if it is maintained in good enough condition to be serviceable beyond this timeframe).

The accounting issues have led to those with influence over public spending on engineering focussing on areas where there is a high level of certainty, i.e. capital expenditure, rather than where there is inherent uncertainty (and therefore risk involved). The historical situation with many national assets is that the current state of those assets is not known and has not been audited. Planning for the maintenance and management of assets of unknown condition clearly entails considerable risk and is therefore unattractive to public servants.

There are two good examples of where asset audits have been carried out, enabling sensible decisions on asset management:

- Swiss Railways has concentrated on capturing asset state and configuration for existing assets accurately over a period of years. Therefore, although it does not have a complete understanding of individual assets necessarily from installation through the whole life cycle preceding the asset system being developed, there is sufficient measurement of the overall population over sufficient time that a statistical based approach to management could be developed with the confidence that the maintenance regimes adopted will lead to condition and functionality within a predictable range.
- Austrian Railways has focussed on measuring condition and quality at installation of a limited number of new assets and then actual maintenance interventions over what is now about a third of their potential lives. From this has been determined the cost / benefit trade off of achieving particular installation quality and a confidence that provided that quality is achieved, asset behaviour under any particular regime may be predicted. This can then be applied to all new assets provided the initial quality is assuredly achieved.

These two approaches have yielded equally valid results which can be copied if the UK is prepared to learn from best practice from abroad.

Industry has demonstrated that understanding the condition and quality of assets allows the risks of asset management to be reduced to the point where companies are able to profit from managing assets as much as from their manufacture and sale. The Rolls-Royce philosophy for 'Total Care' (trade name for 'power by the hour' in their civil aerospace business) is that the maintenance risk is transferred from the operator (airline) to the OEM (Rolls-Royce). This works because the company has the detailed knowledge of the behaviour of the engine, which allows them to manage the risk. They are therefore able to give the customer predictability of cost and reliability of the powerplant. To achieve this, Rolls-Royce use a combination of design, analysis, testing, operator usage prediction and monitoring and engine health monitoring to both establish and confirm the engine attributes that form the basis of a total care contract.

A similar philosophy could be applied to the management of many national infrastructure assets, however, it requires a customer with a long term or lifetime view of the assets and a maintenance provider with a deep understanding of the characteristics of the assets they are supporting to make it work.

It is possible that a certain level of understanding within government of the risks associated with the management of assets of unknown condition was a driver for the transfer of those risks into private hands through Public Private Partnerships. Regulation for the performance of public assets and privatisation of assets and service delivery in cases such as the water industry required private investors to make a (regulated) return on assets. Investors therefore undertook detailed audits of assets which had never been undertaken while they were under public ownership.

The water industry was privatised as vertically integrated businesses. However, the rail industry was broken up into rolling stock leasing companies, train operators and track maintenance. The breakdown in understanding between these organisations of the maintenance risks and interactions of the parts has been well documented; this method of break-up could, potentially have led to organisations not being as concerned about maintaining asset condition and value as they maybe should have been. It has been suggested that bringing rail assets back under a single entity would lead the Treasury to being significantly more aware of the asset value.

Conclusions and recommendations

1. The establishment of a National Balance Sheet of Assets is recommended. Simply auditing the value of assets in a single exercise would lead departments to more accurately account for the value of those assets (seeing that their asset value would diminish if not maintained to suitable standards). In a similar fashion to the Office of Budgetary Responsibility, this would reduce the exposure of the management of public assets to decisions driven by political timescales.
2. There is a need to boost the understanding of asset value both within government and the engineering profession. Within engineering degree courses there is currently little emphasis on the value and maintenance of assets as opposed to engineering of new products and assets. The teaching on new engineering graduates should include a better understanding of assets and their lifetime management.
3. There appears to be limited understanding within government of the interdependencies between sectors. Better cross-departmental coordination could lead to significantly better value for money in terms of reducing collateral damage in other sectors and by taking advantage of opportunities.
4. Many issues to do with poor maintenance of assets were potentially due to public services being run a cash basis with no provision for unexpected outcomes. There was a perceived need to change accounting processes away from in-year accounting so that longer term implications could be more legitimately accounted for.

Innovation and procurement

Innovation occurs at many levels and can be linked to either technologies of processes. The model of innovation as a linear process starting with fundamental research and ending with commercially valuable products and services is an over simplification.

Government is preoccupied by justifying investment in R&D by the return on that R&D spend. It was noted that cost analysis studies had been conducted for science and technology spend, but not for engineering spend. In this context, analysis for supporting science and technology is different to supporting engineering. The success of science and technology research can, to some extent, be measured by the amount of R&D spend that is attracted. From an engineering perspective, success needs to be measured in terms of successful products and services delivered in the market place being bought and used by society. Similarly, capturing the value of engineering innovations derived from R&D spend is complicated by the fact that many engineering innovations can be in form engineering practice rather than products.

In the context of significant cuts (potentially 25%) in university funding, it is inevitable that the innovation process of translating basic science into wealth creating products and services will be damaged. University based research contributes to innovation at all stages from basic science to highly applied research. Research in fields such as manufacturing technology contributes to innovations in practice as well as technological advances. Note – the process of commercialising basic science ideas is a long one and in many cases (with the possible exception of electronics) occurs in timescales that are likely to be longer than the need for radical spending cuts. The vulnerable resources in the innovation process are skills and technical know-how. It is therefore important that people and careers of researchers are the last part of the equation to be cut as they will be the most difficult and slow to rebuild as and when economic recovery allows spending to recover to previous levels.

Innovative approaches and technologies have the greatest potential to increase value for money to the public purse in the field of public procurement, both in terms of the process of procurement and the products and services procured. It was noted that a whole systems approach is needed to be taken when deciding where spending cuts should fall. Much experience had been gained (painfully) within the MOD of overall programme cost increases due to scaling back of requirements or scope after a project has been started.

De-risking of solutions was seen as a major inadequacy in public procurement. As an arms length organisation, the ETI was able to fund 100% costs for design contracts while still allowing solutions to remain competitive but reducing costs at the same time. This approach is unusual in the UK public sector but is industry standard practice elsewhere. For example, the US model for defence procurement works by holding an open competition leading to two winners which are fully funded and developed before a final winner is chosen. The UK used to part-fund parallel Project Definition Studies, to get the best out of each proposer. The cost of funding the development of the loser is not seen as a waste of money, but as insurance against the failure of a single solution.

Downside risks of altering the scope, specifications or scale of procurement projects does not seem to be well understood in government. Short-term spending decisions to delay contracts or reduce numbers have been demonstrated to increase unit costs or programme costs considerably. The engineering community is used to developing

a business case for making an investment; there is an argument for a business case being needed to cancel an activity, to ensure that all consequential impacts are properly considered.

The tendency in public procurement to specify a technology or a product rather than to ask bidders to propose a solution to a requirement tends to squeeze out innovation. It inherently appears more risky to procure solutions rather than products, but the rewards in terms of cost savings can be significant. An element of risk sharing in procurement is also lacking. Charles Haddon-Cave was quoted as saying that the MoD had to recognise that it was an integral part of the supply chain, while at the same time BAE Systems had to recognise that it was an integral part of the defence of the realm. The best systems engineering is done when there is an intelligent customer and the engineering profession has a role to play in helping government become an intelligent customer for engineering solutions.

Once the risk for delivery of a project has been divested from Government to a private contractor, there has often been a tendency to insist on perfection of the delivered project at the cost of time slips and cost overruns. In this context, perfection can become the enemy of the good. There will always be risks involved in any engineering project – the skill of the engineer is to manage that risk within the confines of the delivery of the entire project and if that process is hampered by the customer, cost overruns and an erosion of value from the project is highly likely.

These differences in approach to science and technology, and engineering led the meeting to consider that public sector procurement should be concerned with buying solutions rather than technology. It was noted that many UK firms find it relatively easy to take this sort of approach to Europe, but fail to sell in the UK because customers do not want to take on board any risk. It is worth noting that concentrating on the solution, and how people use services, rather than concentrating on a technology, led to the development of the iPhone – a concept which came out of the UK but was developed by Apple in the USA. The innovation in the design of the iPhone was that it put the user at the centre of the system rather than the technology. The UK's concentration on the "technology" rather than the "solution" is a potential reason for this.

Conclusions and Recommendations

1. Innovation in procurement processes leading to the procurement of solutions rather than technologies will lead to better value for money solutions being offered.
2. Significant progress has been made in public procurement in de-risking projects. However, a change of mind-set to allow funding of alternative solutions up to the point of final procurement, seeing extra cost as insurance rather than waste, could lead to better value and more innovative solutions in the long term.
3. Protection of skills and people in the R&D sector is of utmost importance in an environment of spending cuts. This is because the replace of skills and technical knowledge, once lost, is significantly harder and takes longer to replace than programmes or facilities.

Environment for investment

Much of the discussion in the meeting had concerned public sector spending on engineering. A closely allied area of interest was how could government incentivise, encourage and assist the private sector to invest in providing the products and services required. With the privatisation of many utility sectors, such as energy and water, it is now private sector money that government needs to be invested. In the case of new nuclear build, there is an appetite within the private sector to invest, but some statements coming out of government on reviewing National Policy Statements create intolerable levels of uncertainty for investors. Creating a stable and level playing field for private sector investors is now as important to providing public services and assets as tackling direct government investment.

The meeting noted that the withdrawal of the Sheffield Forgemasters loan by Government was particularly damaging to the nuclear supply chain in the UK and that Government must take a more systems based approach to understanding how such interactions affect the delivery of public policy objectives overall. It was also noted that the Sheffield Forgemasters loan was underwritten by the industry that needed Sheffield Forgemasters as part of their supply chain, so represented very low risk to the public purse.

The meeting agreed that the engineering profession was currently failing to make the case that there are quite simple actions that Government can take to help release private investment and that this discussion is, in part, separate to any potential cuts in public spending.

Conclusions and Recommendations

1. Currently, a significant amount of critical public services (utilities) are provided to society by private companies. Considering the stability and functioning of regulated markets is now critical to the delivery of public services and assets.
2. Government policy and support must be stable and planned for similar timeframes as private industry use in making investment decisions

Accountability and maintaining competence

The stable and level playing field for investment is also of extreme importance to the provision of a skilled workforce as the timescales involved in providing those skills in a sufficient and timely manner requires possibly even more time than the delivery of assets.

It was clear to the participants of the meeting that there is a need to maintain a competent workforce. This is often difficult in the face short-term decisions being made in the political arena. The solution to this was thought to be for those with responsibility for public spending to have a better understanding of their supply chains and the overall effects of their decisions on that supply chain. Charles Haddon-Cave's comments above on the interrelationships between government as customer and the supply chain and the importance of government becoming an intelligent customer are equally relevant here.

There was discussion about which bodies speak for engineering in the UK. It is clear that politicians have some misapprehensions about large spending commitments on national infrastructure projects, but this does not seem to be so strong in areas such as medicine where relatively strong bodies such as the Royal Colleges and the BMA exist. It also seemed easier for politicians to link spending in health to safeguarding service delivery as compared to engineering. When having to discuss multi-billion pound public projects with politicians, it was reportedly difficult to engage Ministers on the future downside risks of inaction. Ministerial boundaries were also seen as a barrier to discussing downside risks, as they often fall outside of a particular Minister's remit; for example, the downside risks of a failure in the transport system are felt in the business community rather than directly by the transport sector.

Some issues with obtaining bad value from engineering projects could be traced back to government placing the accountability for delivery in the wrong place. If accountability is vested within the procuring department, risk aversion becomes the primary driver. Vesting accountability in the engineers delivering a solution (rather than a technology or product) could lead to more innovative and better value solutions being implemented. This point links with those made under "procurement".

Politically driven funding cycles were seen as a particular impediment to demonstrating the value of maintaining assets, partly because the visibility of those assets is low in comparison to new demands for capital expenditure.

The concept of accountability within Government could be altered so that departments can be seen increasingly as "consumers of value" rather than as "spending on technology" This value proposition requires an ability to look forward at where the value in society can be accrued. For example, looking at drivers for policy in the next century, it would be quite easy to create the case that society would benefit from the value of investing in solutions for an aging population, new materials, independent living, etc.. Slightly harder, is to create this value proposition for investment in maintaining existing infrastructure rather than new infrastructures.

Conclusions and Recommendations

1. Skills and technical competence need to be maintained. If procurement spending is lumpy, rather than steady over time, there is a danger that key skills and competencies will be lost between major orders, adding significantly to the cost of restarting programmes. This is currently evidenced by the aging demographic of technically competent engineers in the nuclear industry. Public procurement

2. Government should more closely associate itself as being a procurer of value and of services rather than of technical solutions and equipment.
3. Better understanding of the links between capital expenditure and the provision of services beyond the health service is required.

Global esteem

The UK engineering profession was thought by the meeting participants to be held in high esteem worldwide. The management capabilities in the UK are extremely proficient but UK companies are still bound only to offer what the customer has decided it wants from a technology point of view rather than being able to offering the best engineering solution. This inevitably leads to higher cost options being specified and accepted by government.

In terms of project management and delivery, UK firms have a good worldwide reputation. UK civil engineering contractors are involved in many overseas contracts, notably in the Gulf. On government contracts, however, UK reputations do not appear to be as good, but, as has been noted previously, UK companies often find it easier to secure non-UK government contracts than UK government contracts.

It was noted that a significant number of apparent cost overruns in the UK are in fact due to government budgets being based on first estimate costs, after which specifications and scope had been changed. Bidding processes were also seen as a huge disincentive to the most innovative and smaller companies getting involved in government work. Typically, 5% of the cost of a contract could be spent by each bidder in the bidding process alone – this is money spent (that has to be covered in contract prices) for which the public sees no value whatsoever.

Innovation in delivering public assets is often seen as better elsewhere in the world. A potential reason as to why this is so is that if planning and approvals for major infrastructure works take up to eight years, any innovation there was in the original proposal will be out of date by the time of final delivery. In order to speed up the local planning and approval processes, the idea of volunteerism, championed by CoRWM was seen as a possible solution as well as enabling local communities to be incentivised to allow certain developments

Conclusions and Recommendations

1. A significant amount of costs could be taken out of the procurement process. Much of the duplication entailed in the bidding process, while superficially ensuring fair competition, represents spending for which the public purse sees no value or return.
2. Government should learn from best practice in public procurement from abroad. A number of alternative mechanisms have been highlighted at various points in this paper.

General Conclusions

The purpose of the meeting was to examine public speeding on engineering projects and how that spend might procure better value for money for the public purse. Key conclusions that emerged included:

1. A better understanding of both the value and state of current assets should be developed by government urgently. This would lead to obtaining better value from current assets, avoid needless renewal in response to certain events due to lack of knowledge of asset condition and potentially reduce or delay the need for major capital expenditure by providing the economic and safety case evidence for prolonging the service life of certain assets.
2. In thinking about public procurement projects government should concentrate on the public services those procurements are designed to deliver rather than concentrating on reducing risk attached to the purchase of particular equipment.
3. Decisions on procurement of national assets must be taken in light of the timescales over which those assets are expected to deliver public services.

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