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**Title: Learning to manage mega projects: the case of BAA and Heathrow Terminal 5**

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# **Learning to manage mega projects: the case of BAA and Heathrow Terminal 5**

## **Introduction**

This paper examines how over the past decade BAA – a major client and project management organisation – implemented a strategic programme of capability building to improve the management of projects at Heathrow airport. These range from routine capital projects to a one-off mega project – Terminal 5 (T5). The paper concentrates on the learning gained from previous projects, individuals and organisations that contributed to the innovative approach used to manage the T5 project. The T5 project uses ‘integrated team working’ to ensure that safety, time, budget and quality constraints are met. It has already reached 50% completion (March 2005) on time, within budget and with a high safety record. Under the ‘T5 agreement’, BAA holds all the risks associated with the project rather than transferring the risks to external suppliers.

The T5 project is Europe’s largest and most complex project. The project, which has been called a ‘landmark project’, is also an example of a ‘megaproject’ (Flyvbjerg et al, 2003) because of its scale, complexity and high cost and its potential to transform the project management practices of the UK construction industry. It is broken down into 16 major projects and 147 subprojects. At any one time the project employs up to 6,000 workers, and as many as 60,000 people will have been involved in the project over its lifetime. The goal of the project is to increase the airport’s current capacity of 67 million passengers a year to 95 million passengers a year.

## **Conceptual background**

This paper builds on and extends the scope of previous research based on studies of capital goods suppliers, which showed how firms could build new project capabilities over time as they learn from their previous project experiences (Davies and Brady, 2000; Brady and Davies, 2004).

It has been suggested that compared with the systematic learning that takes place in high-volume functional or business process organisations, the one-off and non-recurring nature of project activities provides little scope for routinised learning (Winch 1997; Hobday 2000) or systematic repetition (Gann and Salter 1998 & 2000). A further challenge is that in project based firms there is often a disjuncture between project-based learning and company-wide business processes (Gann and Salter 1998). The problem with this perspective on project-based learning is that it equates project-based activities with non-routine behaviour.

Challenging this perspective on project-based learning, Davies and Brady (2000) have argued that performance in project based organisations can be improved through exploitative learning because firms undertake ‘similar’ categories of projects which involve repeatable and predictable patterns of activity. Projects are similar when the same capabilities and routines are required for their repeated execution. The perception that projects perform only unique and non-routine tasks often conceals many potentially transferable lessons. Knowledge creation and learning can occur at

several different levels (such as the individual, project, firm or industry) and often as an unintended by-product of the project activity (DeFillippi and Arthur 2002). Brady and Davies (2004) propose a model of project capability building (PCB) for project-based firms consisting of two interacting and co-evolving levels of learning. The first level involves a series of bottom-up 'project-led' phases of learning that occur when a firm moves into a new technology or market base; the second level involves 'business-led' learning (within which the project-led learning is embedded) that occurs when top-down strategic decisions are made to create and exploit the company-wide resources and capabilities required to perform increasingly predictable and routine project activities. On a spectrum of projects ranging from 'unique' to 'repetitive' (Lundin and Söderholm, 1995; Davies and Hobday, 2005), the PCB model was applied to a category of projects that evolved from a first project of its kind (starting out with unique characteristics) for a single customer to a full line of repetitive projects in a growing market.

The paper extends the PCB model beyond the single supplier firm and its repeated execution of similar projects to include the actions of the major client and its interaction with the network of firms that come together to deliver repetitive capital projects and unique mega projects. It focuses on the deliberate strategic efforts made by BAA to improve the delivery of routine capital projects and a one-off mega project – Heathrow's T5 project. To achieve its objectives, BAA implemented a far-reaching strategy to change not just its own capabilities but those of its main suppliers as well. Partly because the planning process for T5 was so protracted BAA had the opportunity to learn from on-going projects both at Heathrow and elsewhere. This was an important element in the creation of the T5 agreement which was developed to provide an environment in which it would be possible to deliver the T5 project.

## **The research**

This paper is based on research undertaken in two distinct phases. The first phase took place in 1998-1999 when a study of BAA was carried out, involving two capital projects being undertaken at Heathrow Airport: a new baggage handling system at Terminal 4; and the International Arrivals Concourse at Terminal 1. The two case studies were based on around 20 in-depth interviews (approximately 2 hours per interview) conducted with managers at multiple levels (project directors and project managers) in BAA and its main suppliers. These project case studies are used to provide an analysis and benchmark of BAA's attempts between 1998 and 1999 to improve the efficiency of its project processes for repetitive capital projects. This was a critical juncture in BAA's efforts to use its previous project experiences to help shape its approach to the set up of the T5 project.

The second phase is based on a current study of a one-off unique project - the Terminal 5 project (2005-2006). The case study focuses on how BAA is capturing the learning gained from previous projects and from other contexts (e.g. BAA, other projects, firms, consultants and industries such as the car industry) that have been important to the creation of BAA's new project management approach for T5. The research includes an analysis of important previous project experiences leading to the creation of the approach used to manage the T5 project. A series of interviews have been carried out with senior managers involved in the planning and execution of the T5 programme. BAA has used its previous project experiences and processes to

develop a new organisational approach to project management which has been developed specifically to deal with the unique challenges of T5 (*Ingenia*, 2005).

## **Learning to deliver T5 – empirical findings**

### *Background*

BAA (formerly the British Airports Authority) is the world's largest commercial operator of airports, responsible for seven UK airports and managing a range of activities in various other airports around the world. BAA undertakes hundreds of capital projects as part of its ongoing operations, as well one-off mega-projects, such as the design and construction of Stansted Airport and Heathrow's Terminal 5. In 1994 BAA's capital projects programme was running at £500 million but it was planning a series of major projects including the development of Terminal 5 (the largest project BAA has undertaken). This ambitious capital programme had to be undertaken against a background of steadily rising costs of building while the charges they could levy on their building occupants were rising at a lower rate since they were subject to regulation.

The primary driver then was to find a way of reducing the costs of providing facilities. But there was another strategic objective - to make BAA the best client in the country, and to create a team and all the planning and all the preparation for T5. To achieve this objective, BAA set about implementing ways of improving the efficiency of its ongoing capital projects that would enable them to show continuous improvement in performance and developing the project capabilities required to manage the massive T5 project. Senior management embarked on a strategy to turn BAA into the most capable and sophisticated project management client in the UK. They brought in experienced people from outside BAA to spearhead this strategy, people who had worked on massive projects for demanding and sophisticated clients in other sectors.

### *Early moves*

A group technical director was hired to oversee this process in October 1994. He had previously worked in a major consultant organisation which had experience of implementing major projects around the world. One of the first things he did was to commission a survey of BAA's customers, the airlines and the retailers, asking them their opinion of BAA as a client. This was done professionally by an external consultant and the results were revealing:

*"Basically it was a horror story. We were the client from hell - incompetent, no process, blah, blah, blah. So we actually published that, and that became the starting point."* (interview with the former group technical director).

At the time BAA's Chairman was John Egan. He had previously been involved in the car industry and was unimpressed by the practices he observed in the construction industry. In particular, he could not understand why BAA, viewed each project as if it was a complete blank sheet of paper and why a new team was formed for each

project. This practice meant that the project team had to work from first principles over and over and over again. Egan had seen the huge improvements in productivity that had been achieved in the UK car industry by looking at and implementing best practice from around the world. The first time he met the newly appointed technical director he gave him a simple brief: go out there into the world and find out what's best in construction and bring it back here. He also gave him a budget of £2 million to facilitate this process. Senior managers in BAA visited the lean construction institute in Stanford, California and spent time with leading clients from other sectors – e.g. Tesco and Macdonalds from retailing -and also companies from the car industry such as Nissan, Rover and Unipart.

*“John’s challenge was very much one of how do we get more of what in the automotive sector, and indeed other industries, would be seen as an orderly approach to project delivery and an orderly approach that therefore concentrated on picking partners and arrangements of organisations where you could concentrate on getting better at getting better, and you could compress the start to finish time.” (T5 Managing Director)*

Thus BAA entered its first phase of moving towards being able to deliver T5 which centred around trying to get more predictability in terms of time and cost in its projects. There were three key strings to this:

- developing new and improved project processes, and
- managing the supply chain which culminated in the development of the first framework agreements.

### *Project process improvement*

BAA’s desire to improve its project processes was evident in its development of a new process for organising projects – the CIPP Process – which was finally introduced in 1995. The intention was to establish a consistent ‘best practice’ process that could be applied to all projects with a value of over £250,000. The process was designed around a typical £15 million building project but it was expected that it could be used regardless of the size of the project right across BAA’s business. A taskforce was set up with project representatives from all parts of the group with the aim of capturing all of the best parts of existing practice and creating a single system. More than 300 people were consulted over a period of eighteen months both from within BAA and also from other companies and industries. The issuing of the handbook was accompanied by a long-term training programme to provide a firm basis of understanding for implementation.

The CIPP laid down a set of key policies or principles – safe projects, a consistent process, design standards, standard components, framework agreements (see below), concurrent engineering and pre-planning – which all capital projects had to adhere to. It provided a template for the organisation of BAA projects, and outlined a seven stage process covering the project life cycle from inception through to operation and maintenance. Each stage included a series of check points which had to be completed and a series of evaluation gateways where the project was assessed by an evaluation team before going to approval gateways for sign-off from local and/or group capital

project committees. To successfully pass through a gateway 8 key sub-processes – development management, evaluation and approval, design management, cost management, procurement management, health and safety, implementation and control, commission and handover - needed to be managed and the outputs from each co-ordinated. BAA developed a process map showing each stage along the top and the sub-processes within each stage, outputs and gateways.

The introduction of CIPP was not without teething problems. The Terminal 4 baggage handling project we examined in 1998 was among the first to apply the CIPP, and while the introduction of the process did not prove problematic in itself, a number of interviewees commented on the procedures it laid down and considered them too mechanistic and rigid for a large capital project. CIPP was incompatible with the processes of the main contractors or the airlines who would be the end users of the baggage handling systems. For example, the CIPP manual stated that costs of the project should be calculated to within 10% of their expected final costs by D-day. However, British Airway's internal procedures required that capital costs (when over a certain amount) had to be calculated to within 5% before they could be approved by their Board. Difficulties also arose in calculating costs as a consequence of the procedures not making provision for a single reporting system for all contractors on the project. This loophole enabled contractors to exploit the differences and inflate and hide costings to an extent. While the CIPP may have been appropriate for standard construction projects it was thought by several interviewees that a more flexible process was needed – for example the fixed in stone dates for the various gateways put undue pressure on the project team to deliver to a particular date whether they were ready or not. Risk management was not adequately dealt with in CIPP – with the result that different processes for risk management were operated by the three project managers associated with the project.

The project also faced a number of difficulties which hampered effective team building. First, there were three different project managers in the space of four years each coming from different companies with different management styles and approaches. Second, there were space constraints which prevented co-location all the contractors at the beginning of the project. Third, new project members (such as contractors with maintenance expertise) were brought into the project late in the day and were not fully integrated into the team and also when new project managers were brought in.

By the end of the case study in 1999 we were told by BAA that several changes had been made to the process for large capital projects which would introduce a higher degree of flexibility during the early stages of design to prevent premature design freezes in the light of uncertainty about requirements.

### *Framework Agreements*

At the same time as it was developing the CIPP process, BAA started the development of what it called the Framework Programme to work with a number of preferred suppliers on an ongoing basis. Up to that point, every time BAA embarked on a capital project they went to tender and through a whole process of qualifying with the result that everyone had to go up the learning curve every time. The five year

framework agreement provided suppliers with an opportunity to learn and to make continuous improvements year by year that would benefit both BAA and the supplier. This was first attempted in 1993-94 and subsequently became widely used. Framework agreements were not restricted to first tier suppliers, they encompassed a wide range of services including specialist services, consultancy services (design and engineering), construction services etc. Each agreement was done slightly differently depending on the nature of the service but the concept was applied consistently. Standardisation of components helps to reduce unit costs, but the framework agreements also incentivise the suppliers to improve the products and improve performance. For example, in the case of lifts and escalators, the installation contractors went to BAA and would analyse the process saying if we did it like this and this we could get the lift installed quicker and this would save us time and money.

There were many projects carried out in BAA during that time which were experiments in predictability and repeatability. For example, BAA now has three World Business Centres which were built in succession. In the past, each one would have been dealt with as a separate project, starting from scratch each time. Under the new approach, BAA designed and built the first one and rather than starting from scratch again with a new design decided to replicate the first on a site next door but with a target of reducing the cost by 10 per cent and the time by 15 per cent. BAA then built a third to the same design with similar targets for time and cost reduction over the second one.

In the next phase of learning to deliver T5, attention was focussed on developing new approaches to team working, capability-led approaches and risk management.

### *Integrated team working*

Central to the delivery of T5 has been the concept of integrated teams. The technical director appointed in 1994 brought this experience from a previous major project he was involved in developing facilities for a major pharmaceuticals company. The project had been procured under traditional approaches and encountered serious difficulties with expected completion costs, which were expected to double from £500m to over £1 billion. BAA appointed a trouble-shooter from the US who had been working for the client on another project for the same pharmaceutical company and who had previous experience working in the oil and gas industry. He immediately called a halt to the project, replaced the project team members, and proceeded with a totally different approach based on strong leadership, simplicity and openness.

The simplicity was in creating a team with three parts: the client team, the principal architect/engineer team and the principal contractor. All the suppliers were on open book contracts and costs were re-imbursible against targets. The BAA technical director had been one of the members of the principal architect/engineer integrated team and was running a huge design team (up to 400 at one stage) in close collaboration with the client using management techniques that had never previously been used by UK consultants. The approach was liked by members of the project team. However, it was not liked their parent organisations because the team members became identified more strongly with the project than their own organisations. The

various teams were co-located and fully integrated. They were run as if they were a small business with them all taking joint responsibility for the outcome.

Teamwork was mentioned as a major success factor in the Terminal 1 International Arrivals concourse refurbishment project we studied in 1999. There it was claimed that teamwork has been excellent both at the Heathrow Airport Limited level and also through to construction activities where the co-location of the team provided huge benefits. It was also noted that the team members 'left their companies at the door' when they came to work on the project.

A key factor in developing an understanding of the new approaches that had to be developed for T5 was the Heathrow Express Tunnel collapse in 1994. When the tunnel collapsed BAA could have gone down the litigation route and tried to put the blame on the main Contractor Balfour Beatty. Instead they decide to work together as partners to deal with the situation and try to clear the mess and move quickly on to rebuilding. It was during this project that many of the benefits of integrated team working became apparent. At one point Heathrow Express was 24 months behind programme and eventually it was operational only nine months after the original projected date. It became a huge success story within BAA. Once it was finished, the person who had been recruited to work for BAA on that Heathrow Express rebuild project was transferred to the central BAA capital projects team as Group Construction Director, and three years later he became the T5 Project Director.

*" I found myself with two strong feelings – one was to bring the learning from Heathrow Express back into capital projects, and secondly, because at that stage was the early stages of Terminal Five, to get them interested in it too." (T5 Project Director)*

To begin with much of the learning was channelled to developing the CIPP and to making the integrated team working idea work. They experimented with different clusters: the pavement team (for runways, taxiways, links and resurfacing); a team for baggage handling (clusters of suppliers); and cluster of suppliers for buildings (shell and core, fit out etc.). These teams achieved great improvements via pre-assembly and other means.

### *Capability-led approaches*

Although the first generation of Framework Agreements had improved project predictability and repeatability, a more radical approach was needed to deliver T5 where there was a high level of uncertainty involved. T5 had to be constructed while causing minimal disruption to the operations of Heathrow Airport. As it moved into T5, BAA introduced a second generation of Framework Agreements which were valid for ten years rather than five years.

BAA used stringent criteria to select this new generation of suppliers. External benchmarking is used to ensure that each supplier is at the leading edge of capability provision. Should a supplier be found deficient against the original criteria for giving them a Framework Agreement then BAA would set up an improvement plan to bring them up to the appropriate level. If a supplier achieved that improvement over the time allocated for it, then it would remain within the BAA 'family'. If it



failed to make the necessary improvements then BAA would deselect the supplier. This step, which was not possible under first generation Framework, was vital to the evolution of the T5 agreement.

This recognition that BAA had to adopt a capability-led approach for T5 was not restricted to their development of Framework Agreements. It was extended to BAA's in-house capabilities. BAA now employs around 400-500 people in capital project delivery because of its important role in the delivery of BAA's strategic ambitions. BAA deliberately went on a recruitment drive to bring in people from sectors beyond construction. In 1999, it hired around 40 people from sectors like automotive, aerospace, oil and gas, electronics and from all around the world. These people all had MBAs and been working in leading organisations like, BP, Shell, Glaxo Smith Klein-Beecham, Johnson's Controls, Ford Motor Company for two or three years. This provided BAA with in-depth expertise not previously held in-house.

### *Risk assessment*

Between 2000 and 2002, BAA carried out an in-depth analysis of every major UK construction project in the last 10 years (valued at over £1bn) and every international airport that had been opened over the last 15 years. This analysis showed that:

- no a single UK construction project of that size had been delivered on time on budget, safely and to the quality standards that had originally been determined, and
- that not a single international airport had worked properly on day one.

The analysis revealed a common pattern of risks associated with these projects:

*“And you then, of course, ask yourself the question, well if these risks were so predictable why did they keep replicating from project to project to project; which then takes you back into, there has to be some fundamental flaw in the game. And where we got to was the fundamental flaw essentially is the fact that notionally somebody sees that they've got to win and somebody sees they've got to lose...”* (T5 Managing Director)

Based on this analysis of UK construction projects BAA predicted that T5 would be 18 months late, over budget by a billion pounds, and six people would be killed during its construction. The airport case studies showed that it would take three years to build up to moving 30 million passengers a year through the new terminal. BAA expects T5 to do that in its first year of operation since the passengers are already there in Terminal 1 and Terminal 4. There was a recognition in BAA that the only way it could deliver T5 was to change the rules of the game. This meant the creation of a set of behaviours that allow people to be constructive in the way in which they play that game with the new rules. And the T5 agreement is essentially that.

*“The T5 agreement says the new game is I'm not just a client sitting on this side of the table and you are the contractor, which is the old game, new game says that actually I've got to sit on more than one side of the board; so I'm both the client but I'm also a team member and, in some*

*places, I'm the principle contractor as well. On your side of the table you're no longer just the contractor; you're the contractor but you're also a key team member. So where you actually sit within the game changes. In terms of the key rules, ultimately I hold all of the risk all of the time. It's open book. I insure everybody."* (T5 Managing Director)

The T5 agreement is actually a Delivery Team Handbook. It provides an appropriate environment for integrated team working. Rather than transfer risks to its suppliers, BAA assumes responsibility for all project risks and works with its integrated team members to solve problems encountered during the project. The Agreement includes an incentive payment if a supplier achieves exceptional performance. This is designed to enable suppliers to work effectively as a part of an integrated team and focus on meeting the project's objectives not only in relation to the traditional time, budget, and quality measures but also in relation to safety and environmental targets.

BAA decide to adopt this approach since traditional liabilities such as negligence, defective workmanship and the like are extremely difficult to prove in an integrated team environment which they deemed necessary for T5 delivery. BAA recognised that if suppliers were made jointly responsible for running significantly over budget then this would probably put them out of business. It decided to re-imburse the costs of delivery and to reward exceptional performance and penalise inferior performance only in terms of profitability.

## **Discussion**

This paper has shown how BAA realised over time that a whole new approach to project management and project delivery had to be adopted to deliver T5 on time and within budget. Partly facilitated by the long and drawn-out public enquiry into T5 they were able to undergo a strategic programme of learning and development to build up the necessary capability. BAA attempted to learn from within the group, previous and on-going capital projects. However, it also examined other worldwide airport projects, projects in other sectors, and observed leading edge practice in supply chain management and project management. BAA built up internal capability through recruitment of world leading practitioners and external capability by the development of framework agreements tied to regular benchmarking to try to ensure continuous improvements in delivery performance. It recognised that a major source of failure in the past was related to trying to shift risk onto the suppliers and adopted a new approach whereby it assumed responsibility for the risk.

The research findings suggest that the project capability building model put forward by Brady and Davies (2004) can be usefully extended to the case of major clients who are involved in a continuous series of major capital projects. This paper extended the PCB model by applying it to a new context: a large client organisation (rather than a contractor) that is learning over time from various project experiences and developing the capability to deliver all types of projects (unique and repetitive). Furthermore, whereas past research has tended to focus on the project-led learning, this paper presented an example where business-led learning i.e. strategic, top-down learning is more prominent.

In particular the findings confirm that capability building involves an interplay between the two levels of learning – project-led learning and business-led learning. The emphasis of this study has been on the role of the business-led learning. But this has been backed up with the practical learning achieved on real projects. This finding is consistent with the process of a ‘generative dance’ between the epistemologies of possession and practice (Cook and Brown, 2000). The research has also shown up the importance of personal networks in the project business (cf. Grabher, 2004). Many of the people recruited to work on T5 have previously worked together on different projects in different industries and they have developed strong ties which go beyond organisational boundaries.

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