Buildoffsite business case study 003: a modular corridor product for four airport projects

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buildoffsite **BUSINESS CASE STUDY 003**

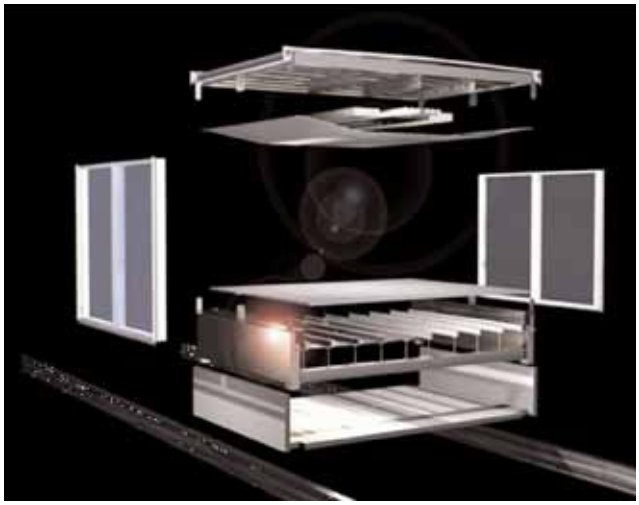
A Modular Corridor Product for Four Airport Projects

Project Details:
The four projects at BAA's London Heathrow and Gatwick airports total £225m in value, with the corridor elements covered in this study accounting for £27m. The corridors, constructed from 4m long modules, segregate departing and arriving passengers in transit to and from the aircraft stands. They measure 3.5m high by 5.0 to 7.2m wide, and range in length from 220 to 408m.

Project Team:

Client:
BAA[1]
Main Contractor:
Common Product Team:
Mansell, Mace Solutions +
Crown House Engineering
Product Architect:
Bryden Wood Associates *
Product Engineer:
*Evolve **
* Plus project-specific design consultants
IMMPREST team:
Loughborough University

The Gatwick Pier 2 (P2) modules (above), built off-site but using traditional construction design, consist of walls, glazing, roof and some services. Modules used in the latter projects (below) benefit from extensive DFMA[2] improvements and incorporate floor cassettes, service modules, and installation aids such as wheels and self aligning connections. Suppliers' manufacturing plants were based throughout England, and assembly of the units took place in a rented facility, modestly equipped with hired plant (<£100k capital expenditure) and located near Gatwick airport.



[1] Represented by the Product & Manufacturing Development Team
[2] Design For Manufacture and Assembly

Project Drivers and Constraints:

Drivers

- Cost minimisation and structured expenditure
- Improved level of service for passengers
- Re-usable design across four projects
- Safety and Quality

Constraints

- Operational constraints of a live airport environment, including security, passenger safety, restricted access and working window.

BAA
The world's leading airport company

I.J.Graham; C.L. Pasquire; A.G.F. Gibb

Loughborough University

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IMMPREST evaluation

Loughborough University's IMMPREST[3] toolkit was used to analyse the cost and value of BAA's modular corridor product. The benchmark study used for comparison was carried out by Turner and Townsend and determined the cost of Gatwick P2 had it been traditionally constructed. Benchmark costs for the three subsequent projects were extrapolated on the basis of floor area[4] .

COST ISSUES

Total cost saving over the four projects £ 15.5m = 36 %

A Manufacture and Installation Costs

Traditional cost per linear metre	£ 19,386		(£ 24.1m total)
Offsite cost per linear metre	£ 15,479		(£ 19.2m total)
Cost saving per linear metre	**£ 3,906**	**= 20 %**	(£ 4.8m total)

Project Breakdown	Trad. Cost £/m	Offsite Cost £/m	Saving £/m	Project Saving	Benefit
Gatwick P2	20,798	15,834	4,964	£1.69m	23.9%
Heathrow T3-P5	20,424	17,845	2,579	£0.70m	12.6%
Gatwick P3	18,551	14,544	4,007	£1.63m	21.6%
Heathrow T3-P6-VS	17,465	13,730	3,735	£0.82m	21.4%

Costs considered: Materials, labour (off-site and on-site), scaffold and transport.

By far the greatest benefit is achieved through the continued reduction in labour costs achieved by moving production off-site and improving the production and installation efficiency. Material costs vary proportionally, but normally provide a modest benefit. Transport costs associated with delivering the modules are small by comparison, as are the benefits of reduced scaffolding costs.

B Project Costs

Traditional cost per linear metre	£ 10,065		(£ 12.5m total)
Offsite cost per linear metre	£ 6,664		(£ 8.3m total)
Cost saving per linear metre	**£ 3,401**	**= 34 %**	(£ 4.2m total)

Project Breakdown	Trad. Cost £/m	Offsite Cost £/m	Saving £/m	Project Saving	Benefit
Gatwick P2	11,477	5,991	5,486	£1.87m	47.8%
Heathrow T3-P5	11,103	6,605	4,498	£1.23m	40.5%
Gatwick P3	9,230	5,676	3,554	£1.45m	38.5%
Heathrow T3-P6-VS	8,144	9,611	-1,468	-£0.32m	-18.0%

Costs considered: Site welfare, storage, craneage, security, design, management and factory overheads.

Increased design costs associated with the modular construction are modest (reducing benefit by between 3 and 8% in this category), as are factory overheads (5 to 14%). These increased costs of offsite are partly countered in this case by savings in site accommodation, storage and security.

[3] www.IMMPREST.com

[4] The actual savings on these later projects were somewhat greater than those stated because of their narrower corridor widths (Heathrow T3-P6-VS mean width is 5.75m apposed to 7.24m for Gatwick P2).

The cost of craneage was high for the first project, incurring a 10% disbenefit. This was addressed in later projects by applying One-Point Lesson[5] technique to the installation. The situation was reversed, and from then on craneage costs provided a saving over a traditional approach.

The falling benefit in this section is mainly due to the way the benchmark costs were calculated, but is also a result of decreasing savings made in management overheads. The high management cost of Heathrow T3-P6-VS is attributed to the complexity of the site which required three different widths of module (with no adjustment being made to the benchmark figure to reflect this), and is exaggerated by a shorter production run and the lower production rate (takt time) required.

C Life Cycle Costs

Cost saving per linear metre **£ 5,223** (£ 6.5m total)

Although whole-life costing was not covered in this study, business benefits are included in this category, and arise from the reduced time on site and consequent reduction in loss of revenue from stand closure. Also considered is the cost of finance avoided on the total savings.

Project Breakdown	Saving £/m	Project Saving
Gatwick P2	4,827	£ 1.64m
Heathrow T3-P5	4,035	£ 1.10m
Gatwick P3	3,089	£ 1.26m
Heathrow T3-P6-VS	11,264	£ 2.48m

OTHER BENEFITS

Time

These figures are based on the estimated on-site time savings of each of the projects, using extrapolated values from the Gatwick P2 Benchmark study as a basis.

Project Breakdown	On-site time saving (weeks)
Gatwick Pier 2	19
Heathrow T3 Pier 5	9
Gatwick Pier 3	14
Heathrow T3 Pier 6	26

Quality

Quality benefits outnumber detriments 5 to 3, resulting in a moderate overall benefit. Areas of particular advantage are tolerance, accuracy, consistency, numbers of defects and susceptibility to damage (there being less trades involved in the construction phase). The quality shortcomings arise from information management and flow during design, manufacture and installation.

Health and Safety

All of the criteria assessed were rated ‘significantly better’, both for the manufacture / construction phase and for demolition / decommissioning. Particular benefits were a reduction in the numbers of people on site and in difficult or dangerous conditions, in the ratio of operations performed onsite versus offsite, and in the contribution to improved housekeeping.

[5] A TPM (Total Productive Maintenance) method for rapidly communicating best practices

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Sustainability

All sustainability factors listed by IMMPREST, particularly ecological impact, water consumption, waste production, transport, and pollution were deemed to be improved by using modules. In terms of 'people principles', the only negative issue was a lower level of pay to employees on the last project, which used agency staff. BAA's Nigel Fraser (Head of Manufacturing Products & Systems) states in response that these previously unemployed workers gained training and skills, and that the traditional construction workers used for the previous projects were returned to site-work more appropriate to their skill levels.

Site Benefits

Offsite provided universal benefits in addressing the extremely restricted storage and access available on the airport site and in minimising disruption to the operation of the business. With the high security, and all work being carried out during short night shifts, the reduction in the number of personnel and deliveries was of clear benefit.

BROADER ISSUES

During a series of similar construction projects opportunities always exist for improvements from one project to the next, but are rarely exploited in the wider industry. BAA have maximised these opportunities by maintaining consistent teams and suppliers, through training and development in lean principles, and via structured learning reviews after each project. However, it is by 'Manufacturising' the construction of these major built assets that continuous improvement can really be exercised – far more so than would be feasible in a traditional site-based construction environment, where detailed production monitoring and use of performance indicators are difficult. Allied with thorough product development and robust production readiness procedures, large financial and wider benefits have been realised.The team's own comments regarding the deficiencies in information management and flow as projects become more complex are reflected in increasing management costs. This is the area that now needs greater focus if the benefits highlighted in this case study are to be replicated and maximised in future projects

LEARNING FOR THE FUTURE

Selected comments from the BAA project team:

Learning points throughout the four projects:

- *Remove structural duplication*
- *Maximise offsite content (including services)*
- *Allow sufficient time for production readiness*
- *Emphasise supplier evaluation and development*
- *Careful design of interfaces with existing buildings*

Learning points for future projects:

- *Co-locate production design teams*
- *Clarify roles and responsibilities*
- *Increase flexibility by developing configurable components*
- *Use IMMPREST to compare building options in the early stages of a project*