TOOL D.1

ASSESSING THE PRODUCTS OF A BUILDING PROJECT

1. TYPICAL STAKEHOLDERS AND THEIR KEY EVALUATION PURPOSES

1) Project level designer consultants need to establish that their design concepts meet the client's architectural or design aspirations as well as the client's functional performance needs
2) Clients need to establish they are getting a building that meets their aspirations in terms of its architectural character and its functional performance
3) Prime Contractors and Cluster Leaders need to establish that what is being designed and constructed will perform as expected, because of their responsibility for delivering a building that meets the client's functional needs and with a TLC as predicted
4) Insurers providing cover need to establish that predictions of TLC are sound, particularly with respect to the costs of maintenance and component replacement

1.1. Key Indicators relevant to these evaluation purposes

a. ***Functional performance:*** at Design Strategy stage and for each subsequent stage of design development, designs must meet or exceed functional requirements expressed first in the Strategic Brief, and then in the Project Brief; post-handover, the building or facility itself must meet these functional requirements, including achieving at least a specified level of operational effectiveness

b. ***Design character****:* the architectural or design character of the building from the Design Strategy stage onwards must meet or exceed the client's level of aspiration for architectural interest or distinction, without adding unnecessary cost

c. ***Cost of ownership***: delivery of a through-life cost (TLC) performance for the facility, in terms of a net present value of CAPEX and OPEX, improves on the through-life cost baseline. Up to handover, this will be assessed in terms of progressively refined predictions, and subsequently in terms of actual CAPEX and a combination of actual and predicted operating and maintenance costs.

2. EVALUATION MECHANISMS, ROLES & RESPONSIBILITIES

In what follows, we outline who will need to collect what evidence, and for what kind of use, in order to evaluate performance according to the above three indicators.

1.2. Delivery to meet requirements for functionality and operational effectiveness

In order that the Prime Contractor and Client can evaluate performance of the facility in terms of the functional requirements as it is being designed, it is necessary that the Project Brief is developed in functional terms (See Tool X). The Project Brief should needs to state clearly not only the functions to be supported by the building or facility, but also the level of operational effectiveness required, in terms of throughput, times of operation, minimum availability when down time for an area or a type of plant is needed, and so on. The more exact the brief, the more likely it is that the facility will meet the defined requirements.

In terms of assessing the project during its course, the Client and Prime Contractor stakeholders must sign off the compatibility of the developing design with these requirements at each stage of development. They should also participate in developing the functional brief by participation in the VM/VE workshops (See Tool X). Functionality should be demonstrated to the Client at each stage through use of 3D visualisation software, which allows end users to grasp more easily what the Prime Contractor intends to provide. In more detail:

Evaluation activities

Inception	Client and advisors specify functional performance requirements and design character in Strategic Brief
Project Brief	Prime Contractor, Core Team and Client specify further detail of functional performance and any further refinements to the design character in the Project Brief
Design Strategy	The Client/Key Stakeholders/Advisors compare the outline design or design strategy with the functional requirements set out in the Project Brief, including some consideration of the implications of the design for operational effectiveness.
Scheme Design	The Client/Key Stakeholders/Advisors compare the design (using a 3D visualisation) with the Project Brief, as amended by value engineering. At this point it should meet or exceed the project brief, in terms of both functionality and operational effectiveness. Any shortfall in functional requirements at this stage is unlikely to be recovered, so the 'sign-off' of the Scheme Design is critical. Any change in functional requirements after this stage will carry with it a cost implication for the Client, in terms of a modification to the though-life cost baseline. *Illustration:*
Detailed Design and Prebuild	A further check and formal 'sign-off' should be carried out as above on completion of Detail Design, to ensure that all functional and operational requirements will be delivered, prior to the start of construction on site. As before, any changes in functional requirements will have a cost

implication, but this will be of a much greater magnitude if implemented after construction has begun.
Illustration:

Construction At this stage, monitoring of the performance of processes, as described in Tool D3, is the key to ensuring delivery of the design and its desired performance characteristics

Proving Period Once the building is in use, and into the Proving Period, a further check is required to ensure that the full functionality and operational effectiveness envisaged by the Project Brief, as amended by VM/VE, has been delivered. The user stakeholders can first of all evaluate the overall level of functionality provided, in terms of the degree to which their operational needs are met, using a questionnaire consisting of a simple scoring system, and an invitation to offer brief feedback on what works well and is problematic about using the building or facility. Analysis of these data will lead to exposure of any shortfall in functionality, which can be fed back into the next briefing exercise for a similar facility. The Compliance Plan should set out

Further, in collaboration with the users, the Client should monitor operational effectiveness in terms of a set of measurable parameters explicitly set out in the Compliance Plan. This will set out what data are to be collected from the Client's building manager during the Proving Period. Data are likely to include numbers using the facility per day, hours of usage, running temperatures, and so on. Data on hours of downtime for key elements of the overall facility should also be collected and passed to the Prime Contractor. Where the Prime Contractor is managing the building for the client, either party can provide the monitoring service. Operational effectiveness measures should be compared with those specified in the Project Brief, as should actual downtime with that implied by the planned maintenance and cleaning operations specified in the Compliance Plan. It may necessary to specify a range for each operation, depending on the level of use the building experiences. In general, when anomalies occur, the Prime Contractor and Client will need to discuss what remedial action can be undertaken.

The building should continue to be monitored after the end of the Proving Period, to identify whether it continues to perform as anticipated. Reductions in availability should be evaluated, as they may indicate a repetitive failure in one of the building's systems.
Illustration:

1.3. Achieving an appropriate design character

Design work begins with assisting the client, including users and other stakeholders, in developing a brief that captures the "values" appropriate to the project and the

community of interests that will own and use it. This means considering what kind of design character or architectural language will provide tangible benefits in how people will experience the building, as well as defining how the building will need to function and perform in practical, environmental and economic terms and setting an overall price baseline.

Defining the "appropriate" architectural character for a building or facility is perhaps more of an art than a science, involving discussions between the client and the supply team, in particular the consultant designers. There are however a number of basic questions can be posed to introduce structure and rigour into discussions. The first concerns what tangible benefits may be sought from the way that design character can enhance the quality of life of its users. If the building makes them in some sense feel better, they will be more effective in their jobs or other activities taking place within the building. In the case of a hospital, for example, good design can help patients recover more quickly. Consequently there can be real economic benefits from considering design "values" that enhance quality of life.

Second, consideration of design character may lead to the conclusion that the client wants a building that is in some respects *per se* a striking, distinctive, or even challenging, piece of architecture. Just as valid is the conclusion that, as in the case of both BDB Pilot Projects, functional performance is the overwhelming priority, and that architectural interest is valid only to the extent that it serves the achievement of functionality for lowest cost of ownership.

There is however no reason in general why a building should not try to achieve both architectural interest and excellent functionality. The issues to be considered in any particular case are what architectural aspiration means to the particular client and user community, and what the trade-offs between achieving a particular kind of architectural interest are, compared to the desired level of functionality and through-life cost.

Overall design character thus needs to be assessed at a number of points during design development:

Inception	The Client and advisors to express as explicitly as they can the general character of the design they are seeking to achieve, alongside the functional requirements and price baseline. If there are no aspirations in terms of design character, this too should be clearly stated
Project Brief	The design character to be achieved should be reviewed by the Client and Prime Contractor Core Team, including consultant designers
Design Strategy	The Client and any relevant advisors should review the design strategy proposed by the Prime Contractor and Core in terms of whether it meets the specified design character. The issue may be in terms of whether design has the desired "freshness" or "originality". It may however just as easily concern whether the design exhibits aspirations that in some respect

exceed what is required whilst adding cost and offering no real advantages in terms of functionality.

Illustration:
When making a decision on design strategy at Wattisham, the core team of the Prime Contractor staff and design consultants consulted with the potential Cluster Leaders to compare two different outline designs. One was based on symmetrical rectangular enclosure, whilst the other had an irregular floorplate, having been built up from considering the various individual areas needed to meet the functional requirements. The first was obviously superior in its architectural merits. Both met functional requirements equally well, but the second did so with overall a significantly smaller floor area, by a factor of around 30%. Consultation with the M&E designer and Cluster Leader indicated that this translated into a significantly lower through-life cost for the second design. The Client project manager had no hesitation in selecting this second design, given that his brief was to obtain the best through-life cost for the required functionality. The extra space was of no functional value, and the architectural merit of the first scheme was not considered sufficient justification for increasing the through-life cost commitment.

Scheme Design

Before signing off the Scheme Design, the Client and advisors need to check that it conforms to the agreed design character for the Design Strategy. This may involve ensuring key elements of the strategy that affect its overall character or spirit have indeed been maintained. It may just as easily involve checking that no additional elements have been added at additional cost for the purpose of enhancing "pure" design values when these are not required, and when there is also no contribution to required aspects of functionality.

Illustration:

Detailed Design and Prebuild

Again the Client and advisors need to check that the detailed design preserves the intended design character before signing it off.

Construction

From this point, construction process assessment methods described in Tool D3 are used to assure the accurate implementation of the design

Proving Period

During the Proving Period, users can be surveyed to establish their reactions to the design character, as a way of understanding whether the character intended at Project Brief stage in fact has the intended impact. The results of this kind of investigation can be fed into development of future strategic and project briefs.

1.4. Cost of ownership

At any point in the design, construction and use of the building, its projected through-life cost (TLC) takes account of all relevant economic factors affecting the performance of the building over its specified life, including initial capital costs (CAPEX) and costs in use (OPEX). At the early stages of design, both CAPEX and OPEX will be estimated, but as time proceeds, first CAPEX and then OPEX will become based on actual costs incurred.

The evidence to be collected and evaluated on the TLC comprises the predicted lives of materials and components combined with the recommended or anticipated maintenance requirements of the building. It also involves the prediction of running costs including fuel use and cleaning cycles. The TLC can be calculated for any period, but should be based on the business case for the building, and may include for eventual demolition or disposal. The basic technique for compiling this evidence for evaluation is the Cost Model (Tool X) which gives guidance on categories under which the information is assembled and assessed. The Cost Model can be used for the following sequence of assessments during the course of a project.

Inception The Client or their Advisor calculate a through-life price baseline, as detailed in Tool X, against which the appointed Prime Contractor and key suppliers develop design strategy proposals

Project Brief The Prime Contractor and Client need to establish together that the Project Brief that has been developed can be met within the price baseline. If additional elements of functionality or design aspiration have become incorporated, these need to be reflected in revisions to the price baseline.

Illustration:

Design Strategy At the point of making a decision on Design Strategy, the Prime Contractor submits an overall cost plan for CAPEX, broken down according to main building elements, and also sets targets for the various main elements of OPEX. These figures are simply targets that meet or improve on the overall price baseline attached to the Project Brief. The Prime Contractor and supply team must be confident that subsequent value engineering and continuous improvement of delivery processes will allow them to beat these targets.

Scheme Design The Prime Contractor, on behalf of the supply chain team, produces a first level of refinement on a TLC profile for the proposed building based on their value engineering activity during this stage. Guidance on predicting the TLC profile is published by BSI in Handbook 10141, and an International Standard is being prepared on the subject (ISO 15686). Tool C7 gives an overview of what is required. The TLC profile should be accompanied by an outline Compliance Plan, including proving arrangements and durability assumptions (see Tool D2). The TLC profile

is summarised as a Net Present Value (NPV) for comparison purposes. The Prime Contractor, Client and his advisors need to assure themselves that the TLC profile is of an order that meets the price and TLC baselines developed with the project brief, on the assumption that further value engineering to reduce through-life costs will take place during detailed design, and that further costs can be taken out of construction processes and hence CAPEX through continuous improvement during preconstruction and construction.

Detailed Design and Prebuild

The TLC profile should be refined and improved as the design develops and firm decisions on component specification and finishes are made. These choices must always be made with the through-life implications being considered in VE workshops, and again evaluated by the Client and Advisors at the conclusion of Detailed Design to check for their accuracy.

Construction

Proving Period

Data collection starts to enable compliance to be demonstrated (see Tool D2). The extent and detail of these data records has to be considered to ensure that they are appropriate to the contract and building size. At the end of the agreed proving period the data records are used to replace the projected figures in the TLC profile, and a revised TLC and NPV are provided to the Client and his advisors, for agreement that compliance has been achieved. The commercial arrangements between Prime Contractor and Client should contain provisions for where compliance has not been achieved, and also possibly for where it has been bettered.

During the Proving Period, the Building Manager must keep records of failures or unplanned closures, together with an indication of their cause or causes. The Prime Contractor should be informed of all events, and in normal circumstances should attend to the problem with the appropriate Supply Chain member. At the end of the Proving Period, the Prime Contractor must provide a full report of all reliability failures to the Client, together with a record of the action taken.

The Compliance Plan and TLC data will state the anticipated energy usage of the building. During the Proving Period, energy consumption will be measured by the Building Manager, and advised to the Client, his Advisors and the Prime Contractor. This will need to be compared with the degree/day figures used to develop the TLC, and the building usage, to assess whether the actual usage is better or poorer than predicted. It should be noted that the initial energy figures are likely to be higher than predicted until the construction moisture has dispersed and the building temperature stabilised.

Other operational costs will also be affected by the level of use which the

building experiences. These may not have a linear effect, so the Prime Contractor will need to define clearly in its Compliance Plan the basis on which its figures are prepared, and the range which it considers acceptable.

Beyond the end of the proving period, the Client should continue to record running costs and review them periodically against the predicted TLC figures. This will give guidance on whether the building is performing as anticipated, and if the balance between planned and responsive maintenance is as planned. The Client should also continue to keep the Prime Contractor informed of instances of lack of reliability, as there will be a continuing liability issue where the building does not perform in accordance with the stated requirements. Lack of reliability will often be due to defects in design or construction.

The experience of the Building Down Barriers pilot projects suggests that the Prime Contractor and Client will need to assess three particular kinds of evidence at the Scheme Design and Detailed Design stages in order to maximise the accuracy of through-life cost predictions.

Component Life Evaluation

To achieve a predictable through life performance, it is essential to evaluate the assumed life span of individual components and materials. This should initially be done by the supply clusters, but checked by the prime contractor and may also be audited by the client. A suitable audit methodology is available as a Handbook from Building Performance Group, 141-143 Drury Lane London WC2B 5TS. Building Performance Group carry out technical audits for the Housing Association Property Mutual, which provides insurance for premature failure to social housing landlords.

A technical audit can be carried out by the Client or by the Contractor as a design check, but it may be preferable to have an independent, third-party audit. Such an audit may be carried out at various stages during the Scheme Design, Detail Design and Construction Phases, and is completed at the end of the Proving Period, when compliance has been agreed.

Once the Client has accepted the building following agreement of compliance, the Building Manager should ensure that the maintenance and replacement intervals are kept under review and work carried out as appropriate. The record of this activity will provide important data to enable improvements to be sought and achieved in future buildings commissioned by that Client.

Maintainability Assessment

The ease by which regular maintenance tasks can be carried out has a significant impact on the through life cost of the building. If short life components and materials are inaccessible or concealed behind longer life materials, the cost and complexity of the maintenance operation will be increased.

All of the maintenance and replacement operations within the Through Life Cost profile must include the costs of access arrangements, loss of use of the areas affected and consequential costs. The Prime Contractor should express these under labour, material and plant headings, since it will be easier subsequently to compare actual expenditure with the predictions in the profile, and understand where variances have occurred.

Maintainability can be audited at the same time as durability, but requires more information on the location and intended access provisions to allow assessment of the potential on-costs.

After the Proving Period, the Building Manager should carefully record the cost of carrying out the planned maintenance work identified in the TLC prediction. Where the actual cost significantly exceeds the planned cost (ideally in terms of man hours and/or materials), the client should notify the Prime Contractor as there may be a continuing latent defects liability issue if the actual cost of maintenance or repair significantly differs from the Prime Contractor's prediction. Regardless of this kind of implication, the Prime Contractor will need to know where TLC projections have not been accurate in order to learn for the future.

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Collaborative Working Centre – www.collaborativeworking.co.uk
The Collaborative Working Centre of Be is a not-for-profit organisation set up from members of the team that facilitated *Building Down Barriers* to provide consultancy, training and other continuous improvement services to support the development and implementation of collaborative working.

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