Stradbroke Primary School - Case Study

The school environment, its value, measurement, long term improvement and how to maximise the assessment opportunities
28th March 2011

*Education is what survives when what has been learned has been forgotten.*

B F Skinner New Scientist, May 21, 1964
The Intelligent Design Centre
Creative thinking in architecture, engineering and the built environment
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1.0 Case Study Summary

The following document highlights a great many areas where a thorough and integrated approach can add real value to Stradbroke Primary School development process.

The design process is a complex one, no more so than at the outset of the project, and we recognise that changes to established systems cannot be affected wholesale. We do however believe that a more thorough design integration exercise can be promoted which places environmental sustainability at the heart of the process. This approach can act an aide memoir to client organisations in search of maximising true project ‘value’ as well as providing the benefit of ‘closing the loop’ on sustainable buildings and services.

We believe that emphasis needs to be placed on areas where improvements can be made quickly and measurably. Due to current market conditions the areas that should generate the most activity are those that positively affect the project in terms of reducing cost and energy whilst promoting the true value of wider sustainability issues by linking this to the established curriculum.

The concept of ID4S was introduced to the head teacher of Stradbroke Primary School Mr martin Fallon on the 18th January 2011. We believe that the concept was well received and during the course of the meeting we received confirmation that the school would be willing to participate in the suggested Case Study.

Mr Fallon kindly allowed us access to information, particularly in relation to building configuration and energy expenditure which we have subsequently used to establish a baseline position from which to measure subsequent efficiency improvements.

We have used the available information to perform a number of ‘design’ reviews. Each of these assessments has produced actions, which in the main are prioritised in line with current thinking and best practice. However, we are fully aware of the prevailing market conditions and recognise that it is not entirely within Stradbroke’s gift to determine the degree of implementation nor the timing of it. For these reasons, and in line with the fluidity of the Case Study, we have set out to table ideas which, through ongoing discussions with Stradbroke Primary School and Sheffield County Council, can be used as part of a wider investment and future-proofing development strategy.

The key areas assessed as part of the Stradbroke Case Study are:

- Building Design
- Interior Design
- Mechanical and Electrical Engineering (heating and lighting) provision.
- Environmental Design
1.1 Executive Summaries

1.1.1 Building Design

Our approach to this project is to combine an integrated vision of school and landscape; working closely with the potential of community participation and collaboration at all stages. It is our belief that for school design to be effective, and to rigorously test any solutions, that the school and community must participate actively in design and decision-making.

To this end we have conceived our own huge floor based board game - Our Space - which facilitates this process most effectively with the children, whereby their input in all manner of decisions and opinions is collected through active play. This would play an integral part in coordinating the way the client can collaborate within the design process, and be an integral part of the detail design and decision making.

The School Development Plan would be the primary starting point for any decisions in architectural terms. The basis of this plan is underpinned by the DCSF Area Guidance document - BB99 Briefing Framework for Primary projects. This looks at area guidance for both site areas and building areas.

Condition Items would need to be fully surveyed and prioritized through the development plan process, and this would be done from a point of reference in the schools existing Asset Management Plan as prepared by the Local Authority.

Having previously worked with several Schools, the principal aim as Architects and Lead Consultants on a project is to meet the needs of the end users and stakeholders. The main stakeholders - The School/(Governing Body), the LEA and the DCSF all sometimes have differing priorities. They are all linked, however by a common purpose to improve delivery of education services by improving the environment and buildings from which these services are delivered.

Our approach to this challenge is one of collaboration, creative thinking, and communication, constantly striving for excellence in the end result in aligning the schools estate to objectives in line with the School’s Improvement / Development Plan , all through architectural services integrated with both M&E Consultancy and environmental / sustainability assessment through a single consultancy.

An area analysis of the existing Stradbroke estate has been undertaken and tested against the BB99 guidelines to highlight surplus place or shortfall requirements.
1.1 Executive Summaries
1.1.2 Interior Design

Controlled interior improvements to schools, both in decoration and spatial design have been shown, through research and study undertaken around the world, to have measurable, positive benefits on children’s wellbeing and attainment.

Changes at Stradbroke can be undertaken in a numbers of ways, depending on the ethos of the school.

To improve pupil attainment, and their learning environments, changes in classroom lighting, acoustics and colour schemes have been shown to have profound and demonstrable affects. Stradbroke school’s classrooms can be dramatic improved in all these areas.

Beyond the classrooms, further redesign could also be undertaken to enhance the school. The school suffers from inhibiting architecture that creates isolation and dislocation. The major thoroughfares, running the length of the main school building have the effect of splitting the building in two to the detriment of community cohesion. The austere feel of the decorative scheme only compounds this lack of empathy. Its institutional ubiquity also creates problems in navigating the building. Well thought out decoration in the communal areas is necessary in promoting wellbeing, and helps build pride in the children towards their school. A great deal could be achieved by creating a more expansive palette of colour and material finish. Well designed, integrated wayfinding will also increase the positive way in which the major corridors are perceived, and used.

The most expensive option for the school, but one that will create the best environment of all for the children and staff, would involve the reconfiguration and redesign of the classroom nodes at the end of each corridor, to create integrated learning communities for each year/Key Stage group. By amalgamating the corridor and ‘library’ spaces in each node into a single space, unusable floor areas are eliminated, space is maximised and a new, communal learning hub is created.

Whatever route is taken, any changes that are made will be to the benefit of Stradbroke school. All design work is backed up by research and analysis and its outcome judged against cost. Our programme is designed to be easily amalgamated into the school’s overall strategy of improvement, helping to drive up both your environmental and educational standards.
1.1 Executive Summaries
1.1.3 Mechanical and Electrical Engineering

The Built environment at Stradbroke School is one that affords a poor comfort index to both pupils and staff, primarily during the heating season. This is a result of a number of influencing factors;

- The existing LPHW heating system generally comprises of cast iron radiators and a single pipe distribution system throughout the school providing both ineffective and inefficient heat distribution.

- The heat source for the above system is a modular boiler installation consisting of two oil fired boilers, the age of which is not confirmed, however it is unlikely they have SEDBUK ratings are do not have high efficiencies.

- Control of the heating system is via the Council's estates office and by a predetermined time

- There appears to be little or no control regarding temperature on a zoned basis throughout the building

- The building fabric offers little opportunity for the efficient retention of heat, in that the walls have no cavity insulation and the single skin glazing throughout the building in numerous cases is not able to be closed properly. In addition there are many single skin roof lights sited throughout the building.

- Mechanical ventilation to most of the toilets throughout the school would appear to be oversized and poorly controlled. Control to these units it by means of presence sensors however these are positioned in direct line of the entrance and operate when pupils pass in the corridor, resulting in the fans operating for far longer than required and also extracting warm air at too great a rate

In addition the reliance upon oil as a heating fuel can produce difficulties. Whilst the “summer” cost per kWh for oil is a little higher than that of gas, the stability of the price of oil is far worse and subject to increases especially during periods of demand i.e. the heating season.
1.1 Executive Summaries
1.1.4 Environmental Design

The pivotal role of a school in educating the children within a community means that it has unrivalled scope for influencing environmental sustainability across an area and across generations. Estate development need not be done in isolation. By incorporating the sustainability message of the work completed within a school to minimise its environmental impact into the classroom, there are opportunities to deliver this message to a much wider audience than simply the estate management team or teaching team could even go beyond the school itself. The opportunity for combining student learning objectives with environmental messages that can be taken by students to families and friends throughout local areas can provide more cohesive groups through joint objectives (such as has already been seen at Stradbroke Primary when a waste reduction campaign was initiated); can help reduce emissions within the home as well as in the school. Other aspects that could be mentioned in here: taking the energy savings back to homes that might be difficult to access otherwise; making sustainability fun; use the expertise that is available to the school while it is onsite; maximising the potential for financial savings; opens up opportunities for prize money (such as that awarded to the school for its waste initiative mentioned earlier).

This document sets out the baseline annual energy requirements for Stradbroke Primary School. The data is somewhat incomplete, but can be summarised by the following three charts:
Monthly water expenditure data for Stradbroke Primary School during 2010. Several months are missing data, but water expenditure tends to fluctuate from £500-£650 per month. Consumption data was not available.

This baseline data was used to calculate the potential impacts of different energy savings measures. This is provided in detail in this report, which includes a life cycle costing analysis that identifies the costs and benefits associated with different options as well as the potential payback periods.

Finally, we investigated the potential for different financing scenarios to enable large implementation measures, such as implementing the suite of recommendations outlined here, by balancing potential interest rates of banking loans against the payback rates in terms of energy cost savings. The final chart demonstrates that after the first couple of years the financial costs...
savings begin to outweigh the financial costs of a loan and so the school is able to finance large scale initiatives while using the savings to pay back the debt effectively, while also reaping the health, wellbeing and environmental benefits that are associated with such actions.

Gas LPHW Heating & uPVC window replacement
(Investment Outstanding Balance)
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2.0 Background
2.1 History

The pre-cursor to ID4S was initialised during a number of casual meetings between John Pickup Director of The Intelligent Design Centre and Peter Roberts, during the summer of 2010.

Jointly, John and Peter have worked in the construction industry in various capacities for over 50 years. They believe it to be an important point that ID4S grew out of their long-standing friendship and is considered by them to be a timely intervention rather than a less directed and general drive to increase business opportunity. The manner with which services are delivered is of paramount importance, with the principle of returning ‘value’ in the form of direct and indirect benefit to the client at the heart of ID4S.

Subsequent development meetings have lead to the partnered inclusion of skills from Jon Potter, MD of Potter Associates, who’s evidence based interior design skills we believe very much add unique and value to ID4S.

2.2 Outline Concept

ID4S is a concept whose key objective is to assess existing school facilities and provide effective feedback sufficient for the school administration to understand the most efficient and best-informed actions to secure long term improvement within the school environment. As a consequence of professional involvement action will be taken to ensure that full benefit of any recommendations are maximised. Whole-life project costing is key to this approach.

The Approach
To undertake a review of the school environment.

To incorporate assessments of the facility on a number of levels and recommend genuine improvements

To quantify the value of investment based on whole-life analysis

To formulate recommendations on a ‘spend to save’ basis

To investigate and quantify the value of investment across a number of areas

To provide these services to the benefit of the entire school - both teacher and taught
To directly link these and other related services to the National Curriculum

To extend this service to a lasting partnership to ensure on-going and long-term improvements to the school environment
To ensure that the school receives maximum - ‘whole-value’ return for minimal expenditure.

To provide a range of primary core-services reinforced by related wrap-around services

There is a barrier to entry to Environmental strategy and the message of economic savings has been lost in the rhetoric of carbon reduction. Furthermore capital cost consideration still outweighs that of life cycle costings and cost in use.

New build school budgets are primarily concerned with capital cost. BREAM and planning restrictions although beneficial to environmental concerns do not effectively address the issue of future running costs and value for money intervention.

The ID4S offer is broad and far reaching and we feel that it is specifically well suited to the primary school education sector.

Unlike secondary schools which often have a large enough estates to warrant the employment of a dedicated site / facilities manager, primary schools do not. Primary schools are scalable and their curriculum’s fully encompassing. This is key to allow our educational approach to interface on many levels.

Project inception and preliminary planning require thoughtful definition of goals and needs (Project Scope); master planning to accommodate anticipated future needs; evaluation of project alternatives; identification of site requirements; funding requirements; budget authorization cycles and/or financial impacts; and project phasing. There are tools available that help define the goals and objectives for the project that let all stakeholders have a voice in making the project successful. The risks associated with making mistakes in this part of the process are great, since their impact will be felt across the project development process and in the final project results.

The Whole Building Design

Climate change is not only a massive threat to the global environment, it is also perhaps the greatest economic challenge facing us in the twenty-first century. It demands an urgent and radical response across the developed and developing world.

UK Department of Energy and Climate Change, 2010
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3.0 ID 4S - The Findings
3.1 Architectural

Full condition report
Planned maintenance schedule
ID 4S educational objectives

The School Site

Google image of the school site and immediate surroundings
Re-configuring the internal layout:
To maximise the potential of each classroom hub as a space of integrated learning, the areas can be re-modelled to create impressive and coordinated ‘learning zone’ for each set of classrooms, reinforcing the feeling of community between year groups and peers; a ‘home’ that they can feel proud of and a space they will want to ‘own’.
Re-configuring the internal layout:
To maximise the potential of each classroom hub as a space of integrated learning, the areas can be re-modelled to create impressive and coordinated ‘learning zone’ for each set of classrooms, reinforcing the feeling of community between year groups and peers; a ‘home’ that they can feel proud of and a space they will want to ‘own’.
Simple Remodelling:
As a minimum, we should suggest that the window area of each classroom be reduced. This will not only help in creating a better learning environment, but will have an impact on reducing energy consumption.

Area analysis:
Existing Area - 4000sqm (approx) over 2 floors
Guidance Area BB99 (see detail area schedule)
Age 4-11 (425 pupils)
325.6sqm
Nursery (30 FTE)
135sqm
Total 2388sqm - In analysis of the overall areas, the school is currently over area in BB99 Guidance terms by some 1612sqm for a 2FE school based on 425 pupils.
Rationalisation should be addressed through a controlled period of surplus place removal which will have clear savings on running costs offset against the demolition costs.

Re-configuring the internal layout:
To maximise the potential of each classroom hub as a space of integrated learning, the areas can be re-modelled to create impressive and coordinated ‘learning zones’ for each set of classrooms, reinforcing the feeling of community between year groups and peers; a ‘home’ that they can feel proud of and a space they will want to ‘own’.
Site Areas

- Existing Site Area - 41,700sqm (approx)
- BBU99 Guidance Site Area - Varies up to 19,500sqm
- Surplus Site Removal required in the order of 22,200sqm

Existing Site Boundaries

Proposed Site Boundaries
We recognise that there are issues with the site and based on our initial discussions outline below what we believe to be the key concerns.

- Large site boundary
- Difficult to secure
- Difficult to maintain
- Unrestricted public use
- The land in its present form has limited school benefit
- Other security measures have failed - so there is a need for physical separating or public/private space
- The fencing system is not particularly visually attractive

Unlike other sections of this report, it is difficult to apply costs to many of the ideas generated as some of these relate to land ownership issues which would have to be addressed and supported by other external organisations. However, that does not stop us being broader in our view as to possible uses that if delivered may result in income generation for the school.

The two main aspects of the external space assessment that we have therefore focused on are those that in the fullness of time may generate an income stream and those that aim to limit liability. For ease of reference we have divided these suggestions into two headings - Building and Site management issues.

Building management

- Rationalise the existing fence locations. This is illustrated on the attached plan. Costs can be reduced by utilising/relocating the existing fences.
- Vacate part of the building by re-structuring the internal layout. Enter into discussions with other local agencies - i.e. police, care trust, social services, private business (or any agency that would require a 24 hour building presence) to see if they would be prepared to lease the vacated school space. It may be worth offering this space free-of-charge initially as the benefits to site security could be significant.
- Assess what problems are associated with the school and what are associated with the community centre - perhaps the community centre promotes misuse.
Through discussions with the environment agency determine if there are options for the introduction of boreholes for hot water extraction, (similar to the initiative being investigated in Newcastle Upon Tyne).

‘Engineers have started drilling a hole deep below Newcastle in the search for a renewable energy source. The Newcastle and Durham Universities team plans to sink a hole 2,000m (6,562ft) below the planned Science Central site, in the city centre. Scientists hope the £900,000 project will result in water at a temperature of about 80C (176F) being pumped out. The plan is the water could be used to heat the site and surrounding city centre buildings’.

Site Management

- Link with the community to offer community allotments. These could be managed to ensure a ready supply of produce for use within the schools kitchen - with obvious pupil involvement opportunities. (income generation)

- Through the local authority - council and planning, discuss the opportunity to release parcels of land for alternative use, housing, light industrial, etc. (income generation)

- Through discussions with the local authority and relevant neighbourhood groups consider joint land management options. (income generation)
- Enter into discussions with other educational institutions as to whether there are options to release some of the land for associated educational use. Perhaps examine if there are joint community primary school benefits or links to universities. (income generation)
- Establish an ideas competition – open to all local residents, businesses etc to generate use / management opportunities. (income generation)
- Approach organisations to ascertain if there is the possibility that the land could be used for enhanced sports facilities. Open up discussions with Sports England and other interested parties. Grant funding may be available through these institutions.
- Examine if there are possibilities of utilising the site for say a community farm.
3.2 Interiors Assessment

The Way Forward

A number of strategies can be adopted to dramatically enhance the learning environment of Stradbroke Primary School. Each possibility achieves a different degree of benefit and impact on well being, academic attainment and pride for your school’s community.

Depending on funding opportunities and the extent of the work, the school may be required to roll out any interior changes over a number of years.

Decisions on the direction of change can be taken in a number of ways.

‘Invisible’ changes can be made that, whilst making no appreciable difference to the aesthetic of the interior, have been shown to increase academic attainment and concentration. Although the demonstrated impact of such changes are dramatically persuasive, attainment may be only one of the key benefit indicators of any interior scheme you wish to pursue. If the goal is also to inspire and invigorate the children and staff with a new environment, a different approach is needed.

An alternative approach would be to focus on the material look of the interior - the colour palette and surface finishes. Such obvious changes better define spaces, add to classroom effectiveness, and make a positive, if limited, difference to the school by improving the sense of pride in the working environment. Such changes will make the school an inspirational place to be associated with. However such benefits may only be limited in their duration, the majority of their impact lasting only as long as they seem fresh and exciting. Such work would have to be revisited every five years or so to maintain their effectiveness.

A third option is to combine the two programmes already defined with a wholesale remodelling the interior spaces to create a more cohesive school environment. Whilst undoubtedly the most expensive and radical, such changes would redefine the way in which the school operates, making the whole interior work more efficiently, improving attainment, attitude, and happiness amongst the whole community, both staff and children.

The assessment and design ideas of this report has been based on a desk exercise. Plans of the school building have been analyzed, alongside site photographs taken by the working party from ID4S. Academic research has been collated against the known benefits of changes to lighting, acoustics, colour and spatial design. A much more definitive assessment would be achieved with a site visit, and conversations with staff and pupils. We would suggest that such a period of work should constitute the next stage of any interior design consultation, to allow us to arrive at a definitive scheme for Stradbroke.

Overview of Stradbroke School

Stradbroke school has been designed as a two storey, linear building with an entrance block built to link the main school building with a smaller, secondary building where the school hall and canteen areas are found. The main classroom complexes are situated at the end of each long corridor in the main school building. Before reaching them, various ancillary rooms lead off the
corridors, including the major toilet blocks and cloakroom areas. The corridors are institutional looking, with bland carpeting, pale yellow paint and brick wall finish. Doors are utilitarian, and those segmenting the corridor, half glazed fire doors. A small amount of information and work is mounted on boards along its length. The corridors are lit by harsh, white light fluorescents. Red barrier carpet has been laid by the exit of one cloakroom on the ground floor. The toilets and cloakrooms are equally utilitarian, with old fashioned fixtures and fittings, probably contemporary with the building of the school.

Only a few photographs have been taken of the classrooms, but in general they seem to be rather run down, although recently painted a light duck egg blue, and a mixture of floor coverings. Most, if not all of the main classrooms are illuminated by large iron framed windows, some of which seem to be ill fitting or repaired with haste, and harsh white fluorescent lighting.

The main hall is typical with parquet flooring and the same pale yellow used in the corridor colour scheme.

The buildings are flat roofed and their has been water ingress into some of the classroom ceilings.

Through discussions with representatives of ID4S, it seems that two classrooms are used exclusively for children with behavioral and learning difficulties. The ground floor also includes a nursery in the place of one of the classroom nodes, at the end of one corridor.

The school is orientated roughly east west so that one set of classrooms, on the south side of the corridors, are illuminated by the sun, and the others, over the corridor, by flat north light.

**General Comments on the Interior**

As a building, the shapes and spaces of Stradbroke school are not friendly. The interior is defined by the corridors that, being so long and uniform, create an uncompromising and unyielding slice through the building. It creates separation and a feeling of ‘barrier’, confirming displacement between each section of the school community. There is no softening of the uncompromising nature of the surface finishes. There is no joy or excitement.

With such large windows in the main classrooms, there will be obvious light and thermal problems. For those on the south side of the building, over heating and glare will define the summer months and cold must radiate through the rooms in winter. This coldness must be compounded on the north side of the building where there is no benefit from direct sunlight, although the flat north light will give better illumination properties through the summer.

The existing layout of the classroom nodes leaves each classroom isolated from the others by the corridors and ‘library’ area.

It seems that, at every point in the building, each room is left remote and unintegrated, creating a feeling of isolation wherever one is.
Any final interior solution at Stradbroke must address this obvious limitation by creating connections between spaces, producing flow and unity through the building to help community cohesion.

However, such a radical overhaul will be expensive. Smaller, less invasive solutions that have a reduced impact on the fabric of the school but have value in improving attainment levels can be achieved without going through major disruption or expense.

Classrooms:
Without doubt, the classrooms suffer from a few major disadvantages. Firstly, the windows create problems in heat and light control.

As a minimum, we would suggest that the window area of each classroom be reduced. This will not only help in creating a better learning environment, but will have an impact on reducing energy consumption. In the USA, it is recommended that a maximum of 20% of wall space is given over to windows. We suggest that those windows should be set at high level to reduce distraction and glare, and cut down on potential drafts.

As a first step we would also recommend that all white fluorescent lights be exchanged for full spectrum fluorescent tubes that have been shown to improve health, concentration, energy levels, visual acuity, and create a greater feelings of self esteem in children. We recommend that the ends of the tubes are shielded to cut down on the soft X-ray omissions. This has been shown to dramatically improve concentration especially in children with behavioural problems, especially attention deficit.

We would also recommend a new, more thoughtful colour scheme for the classrooms. The wall behind the teacher should be made the focus of lessons by introducing a number of selectable colours, depending on the lesson type and learning attitude needed, using wall-washer lighting; warm colours for increasing brain activity and new learning, cool colours for relaxation and study. Green promotes creative thinking. Colour variation also reduces boredom and passivity.

An acoustic review of every classroom should be undertaken to see if improvements can be made to the sound quality of each space by a change in floor covering, or counteracting flat surface resonance from the walls.

To undertake such work will not change the feel of the school overall but will have a major impact on children's learning and improve attainment.

Communal Areas:
Whilst classroom redesign is critical other areas of the school should, if funds permit, be tackled also. To make the whole school feel more child focused, a scheme to reduce the physical impact of the corridors must be given priority. With a little thought, such corridors could be made exciting and less forbidding, and be used as secondary learning environments. New patterning and colourways should be used on walls, ceilings and floors in and around the cloakrooms and toilet areas to signpost their existence and aid navigation to them. A colour scheme can be created that visually shortens the length of the corridors. Lighting can be introduced along the walls and at the ends of the corridors to create psychological attraction and help propel people positively down their lengths.
The hall and canteen can be tackled as a single unit, giving them a more communal feel by using appropriate colour and lighting schemes, and looking at how best to manage their multifarious uses, creating bespoke storage solutions to optimise the space.

**Whole-Building, Integrated Design Solution**

It seems obvious that the school’s architecture deters integration and feeling of community, with classrooms, and almost all other rooms isolated one from the other by the position of the divisive corridors. Whilst the solutions above demonstrate how each specific area can be enhanced independently, the whole school could be made dramatically more cohesive, spatially and socially, by looking holistically at the interior.

To do this we would recommend that the classroom nodes be developed.

**Existing layout of classroom ‘hub’**.

To maximize the potential of each classroom hub as a space of integrated learning, the areas can be re-modeled to create impressive and coordinated ‘learning zones’ for each set of classrooms, reinforcing the feeling of community between year groups and peers; a ‘home’ that they can feel proud of and a space they will want to ‘own’.

**Major ‘social/learning area’, uniting classrooms into a single integrated unit.**
The central hub learning space with bespoke built library, reading, working and social areas.

This would be the most dramatic manifestation of any interior redesign, taking the remit beyond surface featuring and material/colour finishes and instead looking at how the interior spaces work and how they can be improved. Such re-modeling would involve architectural work but would ultimately see each space maximise its potential. Whatever route is taken, much can be achieved at Stradbroke.

3.3 Mechanical and Electrical Engineering

As a result of a brief tour and inspection of the school by the ID4S team, it was concluded that the main areas of concern with regard to the school’s built environment were:

- Comfort (of both pupils of teachers)
- Energy costs
- Carbon emissions

Of the three key factors listed above, the one of major concern is that of comfort as this not only affects the health and wellbeing of pupils, but also impacts upon their learning experiences.

The key influences on the schools built environment are;

1. The poor quality of the building fabric
   - All windows are steel framed single skin glazing structures resulting in high heat loss; this is further compounded by the fact that many of the opening windows do not close fully further increasing the heat loss from the building.
   - The walls are of cavity wall construction with no evidence of cavity insulation
   - The roof is poorly insulation with a number of single skin roof lights
2. Excessive levels of uncontrollable ventilation
   - Most if not all toilets have large extraction fans operated by means of
     presences detectors, however the detectors are so positioned that they are
     sensitive to movement in the corridor and therefore operate far more than
     is necessary.

3. Inefficient and ineffective heating system
   - Poor heat distribution
   - Inefficient heat source
   - Poor time and temperature control.

4. Unstable fuel cost
   As part of this preliminary investigation into the thermal performance of the
   School building a general dynamic thermal simulation model of the school and
   its present building services has been created.

   The present building performance was reflected in the above model and from
   these a number of options modelled these being;

   - BAU (Business as usual)
   - uPVC installation
   - uPVC and cavity insulation
   - Gas Boiler (95% efficient)
   - Gas Heating and uPVC installation
   - Gas, Heating uPVC and cavity insulation

   Graphs indicating the relative energy and cost savings of the various options
   are illustrated within the Environmental section following. It should be noted
   that any proposal which does not address the structural performance of the
   building will not necessarily improve the comfort condition within the school.

   The most effective option would be the one incorporating the Gas heating,
   replacement windows and cavity insulation. An illustrative graph is shown of
   this within the Environmental section in which revenue cost savings finance
   the cost of the necessary works and provide the much needed environmental
   comfort to pupils enabling them to take full benefit from a deserved learning
   experience.
3.4 Environmental
Measuring the Baseline
Utilities bills for heating, electricity and water were collected and analysed for the year 2010 in order to put together a baseline assessment to compare different energy saving scenarios to.

Stradbroke Primary School is not currently connected to mains gas and instead utilises heating oil for to provide heat throughout the year. Figure 1 shows the data provided for analysis by Stradbroke Primary School for January 2010 to January 2011. High periods of consumption can be seen during the winter months, with three weekly deliveries of 6,000 litres. A reduction in December fuel levels due to national shortages in heating oil meant prices increased and reserves were rationed, so that the school could not obtain the 6,000 litres previously purchased. A top up of 2,000 litres, purchased to make up this deficit and from an alternative supplier, can be seen in January 2011.

This dataset appears to indicate that no heating oil was purchased from January 2010 up until the end of March. Given the high consumption levels in winter months seen in 2010, and the cold conditions experienced in early 2010, The Intelligent Design Centre have estimated that at least two additional purchases of approximately 5,000 litres of heating oil must have been necessary during this period. These adjustments have been used to give indicative cost savings for energy saving recommendations outlined in the rest of this section and can be seen graphically in figure 2. During the summer period oil consumption is likely to be drastically reduced, not least because for six weeks during the summer months there are no students in class. However, it is the author’s opinion that an additional delivery is likely to have occurred between May and October 2010, though estimates have not been included in further analyses. Therefore, the final estimates of annual heating oil consumption are likely to constitute underestimates. This means that savings for proposed recommendations are also likely to be conservative.

Figure 1: Heating Oil Consumption data for Stradbroke Primary School during 2010
Figure 2: Heating oil consumption data for Stradbroke Primary School during 2010, with two additional estimated deliveries shown in light blue.

The dataset for electricity consumption is more consistent and comprehensive than that of heating oil (see figure 3).

Figure 3: Monthly electricity consumption data for Stradbroke Primary School during 2010. Estimates have been taken for July and August (by halving the consumption between June and September) as separate bills are not available.

Monthly electricity consumption for Stradbroke Primary School ranges from just over 5,000 kWh over the summer holidays to over 20,000 kWh during December, but tends during term time to be fairly constantly around 10,000 kWh. Measuring real-time usage through installation of smart meters would be able to better identify key areas of electricity consumption.

Figure 4 shows the monthly costs of electricity reflect this, with most months costing just over £1,000 in electrical expenditure, though peaks are seen in December and March (this may also have been reflected in January and February, but there is no data to support this).

Figure 4: Monthly electricity expenditure data for Stradbroke Primary School during 2010. Estimates have been taken for July and August (by halving the consumption between June and September) as separate bills are not available.

Water bills have been analysed (see figure 5) and the average annual monthly expenditure for 2010 was approximately £575/month. Over the course of 2010, this fluctuated from below £500 to almost £650 per month.
Figure 5: Monthly water expenditure data for Stradbroke Primary School during 2010. Several months are missing data, but water expenditure tends to fluctuate from £500-£650 per month. Consumption data was not available.

Options such as low toilet flush volumes and taps with low flow rates can help minimise the water consumption of the building for a modest investment, however, as the relative cost per litre of water is relatively low, water saving options tend to pay back less quickly than the type of energy saving measures that are recommended here. In addition, the majority of other benefits, such as comfort and learning capacity are better fulfilled by first using funds to rectify heating challenges suffered by the school.

Quantifying the Benefits
The site visit quickly identified that key to making environmental improvements to Stradbroke Primary School was improving the thermal efficiency and leakage of the building fabric and renovating the expensive and inefficient heating system. The existing heating oil based heating system is insufficient to provide enough heat during the winter, so that anecdotal evidence suggests that students must wear their coats in the classrooms during the winter months.

The key options identified for improving the building fabric thermal efficiency and reducing leakage are: to replace the current warped aluminium frame windows with new uPVC frames (whilst replacing the single-skin rooflights with double-skin alternatives) and to insulate the cavity walls. To improve the efficiency of the system, the options investigated require the connection of the school to the gas mainline so as to move from a heating oil based system to a more efficient gas boiler. One option stops here, while further options investigate the implications of replacing the entire heating system (currently composed of an inefficient single pipe system) with a natural gas-based system.

Figure 6 shows the energy analysis of six different alternatives were analysed in full:
- Business As Usual (BAU), with heating oil and windows remaining as they are;
- uPVC window installation;
- uPVC window installation and cavity insulation;
- Installation of a 95% efficient gas boiler (without replacing the heating system);
- Full replacement of the heating system with gas together with uPVC window replacements; and
- A full replacement of heating system, uPVC windows.

Interestingly, an installation of a gas boiler provides almost as much energy saving potential as replacing the leaking aluminium-framed single glazed windows with double-glazed uPVC alternatives across the school, saving almost 150 MWh/annum (see figure 7). However, it should be noted that replacing the gas boiler alone will not resolve issues of comfort in the school.

**Figure 6:** Comparison of annual energy consumption for different option scenarios. Heating energy provided by heating oil is displayed in dark blue, heating energy provided by natural gas is in light blue, and electricity consumption is in grey.

**Figure 7:** Annual energy savings available from different environmental options over and above Business as Usual.

**Figure 8:** Annual financial savings available for different environmental options.

**Figure 9:** Annual financial expenditure available for different environmental options.
The carbon savings available for different environmental options are outlined in figures 10 and 11.

Forecasting the Savings: Life Cycle Costs

Government forecasting models account for unit energy costs to increase between 3% and 10% per year (above inflation). Using 6% as an intermediate rate of unit energy cost increase, we can estimate what the likely future costs of energy are going to be over future years, giving a better indication of the likely impacts of energy saving measures.

Figure 12 outlines the implications of increasing energy costs on various options. Following business as usual would result potentially result in energy costs reaching over £70k per annum in ten years. By installing all recommendations outlined in this report, this figure could potentially be reduced to £10k/annum.
Figure 12: 10-year forecast energy expenditure using an annual unit energy cost increase of 6%.

Figure 13 outlines the cumulative benefit of such increases, relative to a business as usual scenario. Cumulative savings for implementing the suite of recommendations outlined here could potentially result in over £400k of energy cost savings within 10 years.

Figure 13: Cumulative 10-year forecast energy expenditure

The costs of the initial technologies are offset against the financial benefit of reduced energy costs throughout the life of the implemented system. This ‘life cycle analysis’ can then provide payback periods (when the lines cross the x-axis) as well as potential cost benefit analysis, e.g., what are the returns after 10 years. This has been completed for the options identified for Stradbroke Primary School (see figure 14). As identified previously, the gas boiler solution provides the most rapid paybacks, but most options payback within 10 years.

Figure 14: Life cycle costs of different environmental options relative to business as usual.

However, while the most extensive work has not got the speediest payback, there is a method by which all of the recommendations outlined here, which provides the greatest environmental and financial returns, may be financed.
Financing the Preferred Option

The below graph is based upon:

1. An initial finance agreement of £510,000 at an annual interest rate of 6.5%
2. Fuel cost savings of £20,900.00 rising at a rate of 6% above 3% inflation
3. Assumed maintenance costs of £8000.00 with an annual inflation rate of 3%

By using the combined savings of 1 and 2 above it can be seen that it is possible to finance the complete system of replacement gas fired heating, replacement uPVC and cavity wall insulation using the expected revenue budget. This will then enable Stradbroke school pupils to benefit from both ideal comfort conditions and learning experiences.
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The main question is whether incorporating pupil engagement and curriculum contribution adds value to the ID4S approach, we believe that it significantly enhances the works ‘delivery’ package by breaking down established barriers, promoting demystification of an otherwise complex programme and encouraging all party inclusion.

The value of broadening the appeal of external consultancy services delivered within the context of the school environment allows for the sense of project ‘ownership’ to be maximised. Providing the children with a greater understanding of why certain activities are taking place and the benefits these are intended to achieve is capable of influencing attitudes both at school and at home, again widening the benefit even further.

We do recognise that all schools are different and that the opportunities for child engagement should rightly be determined by the head teacher, staff and governors, and for this reason we have merely outlined a number of ideas intended to act as catalyst for the development of a school-dedicated Child Engagement Plan (CEP).

Listed below are a number of activities / suggestions that we hope will inform further discussions in this area. These can relate to some or all of the assessment criteria outlined within this report but for the purposes of this Case Study we have focused on environmental sustainability.

Key areas

School Specific
- Develop Stradbroke’s corporate social responsibility initiative
- Maximise the value of improvements through environmental marketing
- Deliver Stradbroke achievement seminars
- Advise on environmental marketing opportunities
- Assist in raising of the school profile locally, regionally and nationally
- Produce Stradbroke environmental education pack
- Enhance school website – sustainability initiatives
- Produce an interactive web portal for relevant environmental information
- Oversee the installation of energy management software (real-time monitoring)

Pupil Engagement
- Contribute to the formation of Stradbroke Primary School Environmental Awareness Council
- Run the environmental game
- Class demonstrations based on the environmental ‘Box of Tricks’
- Offer direct lesson delivery
- Run design workshops
- Deliver a school improvement teaching theme – including surveys, measuring, designing, planning and programming ‘theoretical’ school improvements
- Include interior design as part of the establish art teaching process

**Staff Engagement**
- Contribute to lesson planning
- Deliver staff workshops aimed at providing key environmental information and determining the most effective way this could be taught
- Produce a schedule of existing environmental guidance documentation and suggest the most appropriate method of use / delivery
- Provide advice in the form of environmental ‘bolt-on’ lesson plans
- Assistance in the planning of ‘Theme Weeks’
- Undertake staff training – environmental best practice

**Community Engagement**
- Produce family engagement documents - enhancing environmental ‘reach’.
- Run in-school environmental awareness activities
- ‘Fair Environment’ – fete based event to raise the schools environmental profile
- Aim – to improve Stradbroke’s environmental ‘league table’ position
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Stradbrooke - The School Benefits

- Improvements in the building management process – maximising potential and minimising risk
- Maintaining project control
- Ensuring scheme ownership and control remains with the school
- Increased transparency of the often complex building management process
- Maximise the value of development through effective understanding – particularly in relation to carbon reduction
- The school will ascertain the likely effects of energy price rises and how to safeguard against exponential increases over the years ahead
- Avoid wasting time and money
- Improved focus on development outcomes
- Team integration to improve risk management and liaison with regards to - teaching staff, governors, local authority, pupils and the wider community
- Genuine project support over extended periods
- The importance of clarity in instruction and guidance
- Advice on changes to complex current legislation and its effects on school performance at all levels
- Environmental best practice / eco compliance – delivered in an embracing and non-technical manner

- Improved budgetary control and a clear understanding of their long term effects
- Improved reporting mechanisms
- The development of truly beneficial partnerships
- Established supply chain, one with experience and a long term interest in the schools wellbeing
- Programme and cost assurance
- Clear budget analysis
- Control and effective management of building conditions and ongoing maintenance
- Improved / simplified contractual arrangements and management
- Quantifiable energy cost savings – with the very real opportunity to reinvest the savings
- Client and project specific advice
- Evaluation of available options to meet business and strategic needs
- Similar project reviews - experience brought from other educational establishment
- Peer performance reviews
- Ensuring that every intervention is transferred into a teaching opportunity
- The inclusion of Evidence Based Design to ensure full value benefit
- The provision of efficiency reports – year on year, leading to a partnered approach to school support and integration
- Encourage pupil involvement
Ultimately, the benefits of applying the ID4S assessment process to Stradbroke Primary School could be significant both in terms of raising the profile and importance of the school environment.

**Alternative support modules (Secondary Services)**
- Ecology module
- Acoustic module
- Community module
- History module
- Catering Module
- Environment / Community module
- Disability Discrimination Audit
- Flood risk assessment
- Asbestos Survey
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6.1 Suggested Delivery programme

Year 1 - Primary Services
Complete the detail in relation to the Case Study material included within this report

1. Environmental Report – c/w costed recommendations / actions (ER1)
2. Mechanical and Electrical Engineering Report – c/w costed recommendations / actions (M&E R1)
3. Condition Appraisal – with specific links to planned and unplanned maintenance (CA1)
4. Architectural Review (AR1) – with links to curriculum delivery
5. Interior Design Appraisal - c/w costed recommendations / actions (ID1)
6. Landscape Implementation Strategy / plan (LIS1)

Year 1 - Secondary Services
7. ICECAP Whole Life Costing Assessment – c/q dedicated energy and carbon calculation and forecasts (ICECAP1)
8. Overall Efficiency Report – assessing projections and programming implications (OER1)
9. Low / Zero Carbon Study – examining opportunities for use of alternative technologies (LZC1)
10. Risk / legislative update and guidance (R/L1)
11. Teaching component (T1)
12. Produce an ‘Educational Benefits Analysis’ and sample report (EBA1)
Year 2 - Assessment / appraisal - follow up
- On-going and updated assessment based on Year 1 outputs
- Ongoing review of energy consumption statistics - general efficiency report
- Produce an ‘Educational Benefits Analysis’ and sample report update

Year 3 - Assessment / appraisal - follow up to years 1 and 2

Year 4 - Assessment / appraisal - follow up to years 1, 2 and 3

Year 5 - Assessment / appraisal - follow up to years 1, 2, 3 and 4
- Project completion report
- Benefit Measurement’ report
- Full 5 year life cycle report - and demonstration of value
- Cost savings review
- ‘Educational Benefit Review’

“Without environmental sustainability, economic stability and social cohesion cannot be achieved.”

UK Department for Business, Enterprise and Regulatory Reform, 2009