



Future Proofing Schools

The Phase 3 Research Reflections



This publication

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Edited by Clare Newton, Sarah Backhouse and Susan Wilks. Twelve named authors have contributed to this publication.

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1] Decommissioned relocatable classrooms as seen from the Calder Highway, Victoria



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The research context

Future Proofing Schools is an Australian Research Council Linkage Project (LP0991146, 2010-2012) with Industry Partners including six education departments around Australia; a team of six Investigators, research associates and a PhD student. The research focus has been on the design of relocatable buildings for Australian schools.

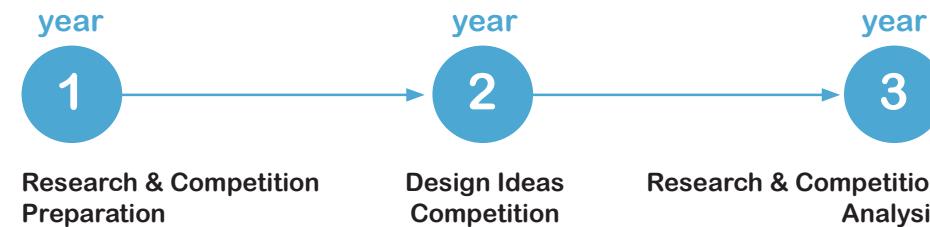
Relocatable buildings are widely used by education departments to cater for changing school size as a result of shifting demographics; in emergency situations after devastation such as fire or flood; and to provide facilities in remote locations. These temporary buildings accommodate a quarter to a third of students in some states and are a significant component of school infrastructure within both state and private schools.

Our research suggests that we have an unprecedented opportunity to benefit from a range of ‘tipping points’ in sustainable school design, 21st century pedagogies and emergent technologies in manufacturing that will allow us to transform the notion of the relocatable classroom.

Foreword

Now we are in the final year of our three year research project *Future Proofing Schools*, it is timely to reflect on our research journey. An innovation in the design of this research has been the inclusion of an Ideas Competition midway through a three phase research process, a decision that has effectively geared the research and its impact in a range of ways.

Phase 1 involved eliciting ‘the voice’ of the diverse stakeholders to develop a series of reference documents which outlined best practice in the four fields of **21C Learning; Sustainable Schools; Landscape Integrations and Connections; and Prefabrication**. It involved visiting schools across Australia to understand educational issues and challenges at both a local and national level. Our research visits engaged with many age groups, contexts and cultures ranging from primary to tertiary education, suburban communities with large representations of new migrants and remote indigenous homeland communities. Understanding emerging techniques in prefabrication and sustainability took us internationally, where conversations with manufacturers, architects and client groups highlighted opportunities, constraints



and inspirational new ideas. An important realisation in doing this research has been the complexity of the design problem.

The *FPS Design Ideas Competition* of Phase 2 asked design teams from around the world to use the Phase 1 reference documents as their Brief for imagining the relocatable classroom of the future, thereby becoming active participants in the research process. The vast range of design ideas from all entrants were overviewed in the Phase 2 publication, some of which are reviewed in more detail within this document.

Since the Competition we have heard from designers of their struggles to formulate successful solutions which resolved the disparate elements within the brief. As researchers, we experienced a similar difficulty. We are a large team from multiple disciplines each bringing our own methodological research framework and ways of defining problems. We use different terminology and tend to write for different audiences. A benefit in working as a team is that we have each become aware of some of the assumptions we make and shorthand we use when talking within our academic or professional discipline.

It has also been useful to see how decisions regarding one discipline affect other areas. For example, providing for effective ventilation can impact acoustic performance, and providing for relocation can impact the integration of buildings into school grounds.

Phase 3 has been a period of analysis and reflection on all these issues. This publication is divided into themes that range from competition analyses and reflections on our own brief, through to observations on remote community challenges and the future of Australia's prefabrication industry. Our twelve authors contribute a range of viewpoints from their respective disciplines, and highlight the complexity of the research area we are exploring.

We have overtly attempted to use a language that sits between that used by a journalist and what might be found in a professional journal. By avoiding academic terminology and structures where possible we are hoping to communicate effectively with the broad audience of stakeholders involved in the design, construction and use of relocatable prefabricated learning environments.

Phase 3 Research Reflections concludes with our recommendations for relocatables of the future.

Clare Newton

Chief Investigator- *Future Proofing Schools*

All Future Proofing Schools Design Ideas Competition submissions can be viewed at:

www.futureproofingschools.com

Contributors

(in order of appearance)

Clare Newton Chief Investigator

Clare Newton is Associate Professor of Learning Environments in the Faculty of Architecture, Building and Planning at the University of Melbourne. She is first-named Chief Investigator on two Australian Research Council Linkage Projects on learning spaces. The first, *Smart Green Schools*, looked at the links between pedagogy, sustainability and space. The current grant, *Future Proofing Schools*, considers prefabricated learning environments.

Clare is an architect and teaches and researches in the fields of design, sustainability and construction. In 2010, the Smart Green Schools' research received a Vice Chancellor's Excellence Award for Engagement.

Richard Leonard Linkage Partner

Richard Leonard is the Director in charge of educational projects at Hayball, a Melbourne-based architecture, interior and urban design practice. He has nearly thirty years' experience.

Education is Richard's primary professional passion and he is a strong advocate for a collaborative design process that draws contemporary learning and teaching philosophies into education facilities. He plays an active role in the education field, sitting on the Regional and the Chapter Boards of the Council of Education Facilities Planners International (CEFPI) and through his involvement with Department of Education and Early

Childhood Development (DEECD), the Boyd Foundation Learning Spaces initiative and in several research initiatives with the University of Melbourne.

Sarah Backhouse Research Associate

Sarah Backhouse is an architect with a practice base that spans architecture, interior design, master-planning, design consultancy and design research. Her project experience reflects her interest in solving clients' complex scenarios through innovative design, and she brings an international understanding of briefing and design for learning environments after 15 years working across Europe and in Australia. She has coordinated the *Future Proofing Schools* project, with a personal focus on researching emerging prefabrication techniques.

Susan Wilks Partner Investigator

Dr Susan Wilks is a Senior Research Fellow in the Faculty of Architecture, Building and Planning at the University of Melbourne. As Partner Investigator on the *Future Proofing Schools* project she brings thirty years' experience in teacher education. This builds upon her involvement in the preceding ARC Linkage Grant project *Smart Green Schools*. Her research, publications and local and international professional development programs have centred around innovative pedagogies and curriculum design with a particular focus on philosophy, visual arts and design.

Jacqui Monie Research Assistant

Jacqui Monie is a landscape architect and urban designer with a background in urban planning. Her work has been largely in the public realm and for local government clients, spanning landscape masterplanning and design development, open space planning, structure planning for urban centres and coastal towns, protecting neighbourhood character and developing housing policy. Jacqui tutors in landscape architecture at the University of Melbourne, and is a part time researcher with the *Future Proofing Schools* team. She will shortly commence a new role as urban designer with Darebin City Council in Melbourne's north.

Lena Gan Research Associate

Lena Gan comes from a design background, is an accredited project manager and worked as a creative director for eight years in Paris, Barcelona and Brussels. She consults in business development and strategic marketing and in recent years, has collaborated with local governments and community organisations in sustainable planning for positive ageing, community development and education. She is a part time researcher with the *Future Proofing Schools* team and is completing a Master of Environment at the University of Melbourne.

Tom Kvan Chief Investigator

Dean of the Faculty of Architecture, Building and Planning and Assistant Vice Chancellor (Campus Development) at the University of Melbourne, Tom Kvan is internationally recognised for his work in the management of design practice and development of digital applications in design.

During his academic career he has worked at the Universities of Melbourne, Hong Kong and Sydney and is an active researcher and author in design, digital environments and design management. His engagement in the design of campuses for educational and industrial purposes spans forms and technologies, including research into the intersection of Physical and Virtual Learning Spaces. He is currently founding Director of LEaRN, the Learning Environments Applied Research Network, and was founding Director of AURIN, the Australian Urban Research Information Network, hosted at the University of Melbourne that is developing a national digital infrastructure to support urban research.

Tom has practiced in architecture in Africa, Europe, Hong Kong and the USA in practices small to large, was director of software development in an IT start-up in California and a management consultant to architects and engineers. He has been a member of the Board of Directors in digital design and facility management associations worldwide and serves on the boards of

several journals and professional organisations. Author of over 140 publications, his latest co-authored book, *The Making of Hong Kong* (Routledge), explores the volumetric city as a sustainable urban form.

Dominique Hes Chief Investigator

Dr Dominique Hes is a chief investigator of the *Future Proofing Schools* ARC project. Her background is in science, engineering and architecture. She brings this multidisciplinary approach to sustainability, based on the understanding that making things more sustainable is about how the whole system works. Within schools, Dominique has a strong belief that the buildings can teach students their sustainability secrets and thus connect learners with their environments.

Philippa Soccio APAI PhD Student

Philippa Soccio is in the final year of her PhD in Architecture. Previously, she worked with Woodhead Architects and Dr Dominique Hes on the preceding ARC Linkage Grant project *Smart Green Schools*. Her work has been largely in learning spaces and sustainability. Her PhD investigates how design can be used to improve the Indoor Environment Quality of prefabricated learning environments. This has involved using environmental monitoring equipment to measure the IEQ performance of eight prefabricated classrooms in five Australian climate zones.

Mary Featherston Linkage Partner

Mary Featherston is a consultant specialising in design of learning environments. The focus of her research and practice is the interdependence of contemporary pedagogy and design. Mary is a Senior Fellow, University of Melbourne and an inaugural member of the Australian Design Institute's Hall of Fame.

Margaret Grose Chief Investigator

Dr Margaret Grose is a Senior Lecturer in Landscape Architecture at the University of Melbourne and is an ecologist and landscape architect. Margaret teaches ecological theory and ecological design. She is interested in play-spaces in schools and public open spaces in relation to opportunities to engage with the natural world and ecological literacy. Other interests are suburban development, ecological imperatives in public open space, dimming streetlights for carbon saving, and colour in the environment.

Kenn Fisher Partner Investigator

Dr Kenn Fisher is recognised internationally as a leading educational facility specialist with experience in both the school and university sectors. He has a special interest in the collaboration between the design professions, students and teachers. He is Director of Rubida Research and Associate Professor of Learning Environments at the University of Melbourne.

01

Including a competition in a research process

by Clare Newton

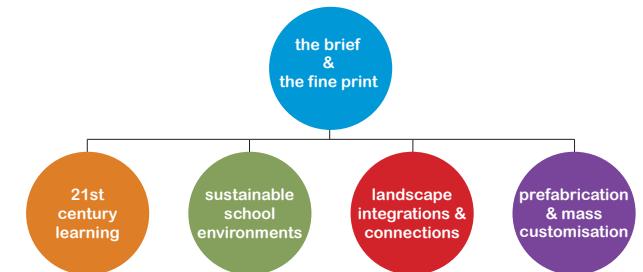
In the *Future Proofing Schools* funding submission to the Australian Research Council (ARC) we were able to argue that a design competition would be an effective way to integrate complex criteria in order to visualise and critique the future of relocatable classrooms. As this is the first time that a competition has been included as part of a successful ARC, it is useful to reflect on the process, rationale, lessons, surprises, benefits and complications of this unusual research methodology.

The Process

The research extended before and after the competition stage. Before the competition, the research team developed a brief to capture current knowledge and help inform the competition entrants. Post-competition we have been analysing entries for themes, omissions, quick wins and innovation. We have also been drawing together knowledge from observation of prefabrication techniques and schools around the world as well as interviews with manufacturers, designers, leading academics, students and teachers into this Phase Three publication. Meanwhile there has been intensive monitoring and evaluation of a range of existing

prefabricated learning spaces in different climate zones around Australia led by CI Dominique Hes and APAI PhD student, Philippa Soccio.

In many ways, competitions are as good as their jury and we had a large international jury bringing diverse expertise. The jury included representation of the client group from two states, expertise in education, two international designers bringing different approaches to the issue of prefabrication and expertise in landscape architecture and interior design. The large jury brought benefits but also disadvantages. The large jury reduced any possibility of schemes being overlooked with many sets of eyes interrogating the entries. The discussions at jury level were respectful of different expertise and specific prizes were awarded for excellence in specific domains. The jury chair facilitated the discussion without participating in the judging and helped the jury return to submissions that had been highlighted early in the process but were not within the final major prize-winners. A shortcoming with a large jury and complex brief is that it is difficult to balance the issue of resolution within all areas of the brief. Invariably it seemed that each scheme had shortcomings in some



areas.

At the close of the competition period, we had received over one hundred entries, with winners from four countries announced in December 2011. Since the announcement we have been reviewing the range of submissions to analyse how they responded to the brief. This has been undertaken using both quantitative and qualitative measures.

The competition entries can continue to be used as a resource by our Industry Partners and we are hopeful that education departments will work further with some of the design entrants in coming years. Some schemes have potential to influence current practice while others are worth exploring further for future solutions. In this final stage, the entries are also continuing to be used by the research team as they conclude the three-year research process.

The Rationale

There are publications on visual methodologies in social research particularly focussing on the use of photography, films, popular culture, drawings and existing objects for ethnographic insights. Visual

representations are also used in both quantitative and qualitative research to represent complex data but design as research in itself is not commonly funded although there is a growing understanding that design research is a valid mode of contribution to knowledge.

Design is an invaluable strategy for working through wicked problems that are so complex that they defy definition. Through design, complex ideas can be tested within scenario settings in order to explore different futures. In this Ideas competition we developed an open-ended design brief with no specific site but with specific problems for resolution. In addition we provided detail on current knowledge in the four fields shown on the adjacent diagram. The information in the brief was too detailed to be fully addressed in any one scheme particularly in an Ideas Competition but we chose to be comprehensive, as we saw potential in the brief as an educative document.

The competition has been a way to ‘gear’ research in a tag team process with design professionals from industry.

The lessons, surprises, benefits and complications

Within this mixed method research context, it is useful to consider the Ideas Competition specifically. *What benefits did it bring and what were its shortcomings?*

The reality of a competition, particularly an anonymous Ideas Competition, is that juries can overlook a subtle design resolution of complex brief in favour of simpler, clearer ideas. Competition entrants

know they need to work strategically if they are to convince a jury. Entrants can deal with complex briefs in a range of ways;

- aspects can be emphasised or hidden in anticipation that the well-resolved components will outweigh the missed considerations, or
- solutions can be provided that, while apparently simple, concurrently resolve many elements of the brief, or
- a clear strategy can be provided that does not resolve in detail but has the agility to accommodate complexity with further development, or
- entrants work with complexity but without reaching final resolution.

We were aware that the brief would normally be considered too complicated for an Ideas Competition. Detailed briefs are used in two-stage negotiated competitions to enable a partial design development of ideas. In contrast, our client group, six education departments across Australia wanted entrants to reconceptualise what relocatable learning spaces might look like in a decade rather than focus on designs ready for manufacture tomorrow.

In analysing the competition entries, entrants particularly focused on resolving prefabrication as the core issue even though we attempted to spread the brief across four domains of interest. Some aspects of learning environments were largely absent from entries because they did not translate into visual design. Presumably entrants assumed factors such

as acoustics and good indoor environmental quality would be included in any design development. What was more surprising was the absence from many schemes of furniture and clear modes of occupation even for particularly unusually shaped spaces.

In this compilation of analysis, the sustainability team have reviewed their briefing document in light of the submissions. They have been able to reflect on their own biases and assumptions as well as those of the entrants. In particular they have been considering the benefits of holistic integration versus the inclusion of ‘eco-badges’. One of the educators on our team has reflected on how children and activities have been included or missing within entries while a landscape architect has looked at connections to place.

While no individual submission would be able to respond to all components of the brief, the submissions have provided a rich range of approaches.

In conclusion

We have not been disappointed by the process but outcomes were not always as expected. Competition entries will remain within an online gallery and the team sees the competition as a strategy to encourage culture change broadly within the Australian prefabrication industry and more specifically within the design of relocatable classrooms.



Design and image by Jonathan Gibb

Competition Reflections

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by Richard Leonard

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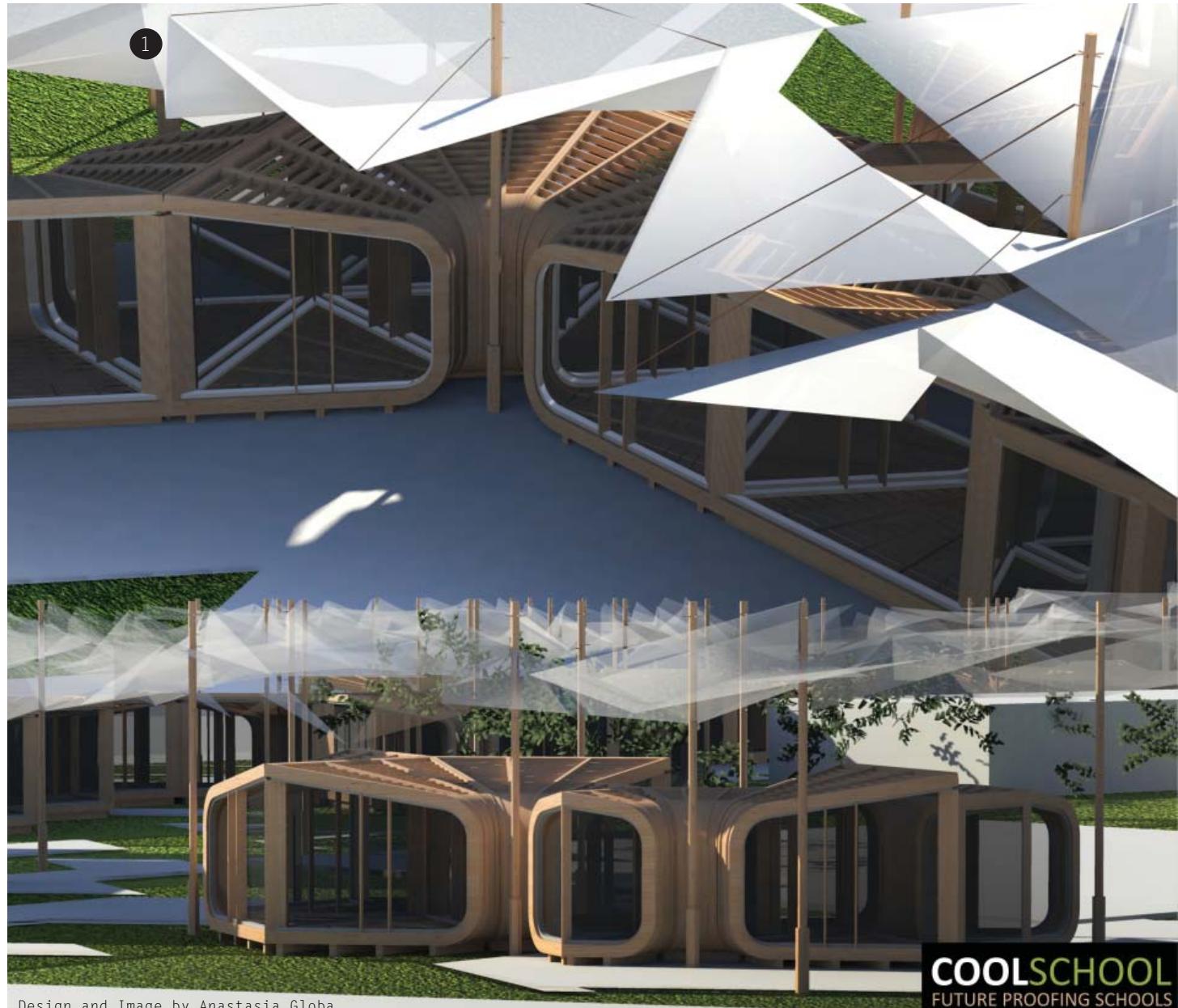
The Challenge

by Richard Leonard

As a young and enthusiastic first year student of Architecture, I can still recall in stark detail the very first design assignment; this was an esquisse to design a simple administration shed for a construction site.

The brief was simple - it had to be functional, transportable, well-designed and cost effective - and you had 3 hours to develop the ideas and complete the task. The rationale and challenges in the exercise are obvious; it was about taking a seemingly simple object, understanding its core requirements and redefining it into a better model. Despite its seemingly innocuous appearance, it was a corker of a challenge.

And so too was the *Future Proofing Schools Design Ideas Competition*, challenging designers to take the modest relocatable classroom and redefine it to address contemporary education and environmental goals. Even more challenging, the ideas competition encouraged designers to “move beyond current practices into tipping point possibilities of education, sustainability, design and manufacture”. Again, a corker of a challenge.



COOLSCHOOL
FUTURE PROOFING SCHOOLS

The competition

This ideas competition crystallised a “perfect storm” of challenges in contemporary education - delivering innovation across a varied physical and pedagogical landscape, to all people, in all ways and in cost-effective solutions. And it added to these the real-world issues of sustainability and implementation.

At the simple level, the competition progressed the notion of the prosaic and very essential relocatable classroom - the facility that is generally considered the orphan of many a school campus; an imperfect, unloved but necessary fixture that has to be endured in almost every school. In the bigger picture, the competition addressed some of the key facilities issues of our time - how do we respond to the delivery of new education facilities with the accumulated intelligence we now have on the multiple ways of how students learn - and how do we match that with cost-effective, responsible and creative built solutions in a sophisticated and informed post-industrial age.

In defining the problem, all designers faced a multitude of competing requirements. The challenges are immense and, applying the competition briefing documents, designers needed to encompass at least:

- **Traditional Teaching:** Traditional teaching remains part of the teaching and learning landscape, so how do you maximise the directed learning opportunities? How might the design embrace multiple teaching and learning modes?
- **21 Century Learning:** How is contemporary education best delivered? How can that be

delivered in relocatables? What is the impact of new technologies?

- **Sustainable Design:** What is possible and what is feasible with the inclusion of ESD? How do you deal with the vast difference in climatic zones within which relocatables will be positioned? How do you integrate both indoor and outdoor learning?
- **Regenerative Design:** How might the buildings provide teaching tools in themselves - be the 3-D textbooks?
- **Mass Production:** How might manufacturing provide cost and time efficiencies? How might value-add to the design?
- **Mass Customisation:** How can standardised design be made adaptable and flexible? How can school expansion or contraction be accommodated?

All of the above needed to be assessed, considered and then synthesized by the designers into ideas of substance and possibility.

The responses

At the core of the competition responses, many designers held contemporary learning - and more specifically, the student-centred, experiential, collaborative model of learning - as the central, defining challenge. Most of these were matched with solutions for expansion, adaption and customisation.

In this sense it was pleasing therefore, to see how many competition entries considered the relocatable

response in an aggregated or even whole-school context. For many schools, relocatables are all they will ever know and is, in fact, a permanent solution. And if the relocatable model can be designed as a successful one, then why not consider its wider application as a genuine education solution even as a permanent option? Modular buildings successfully offer realistic development options in many residential models - so why not schools?

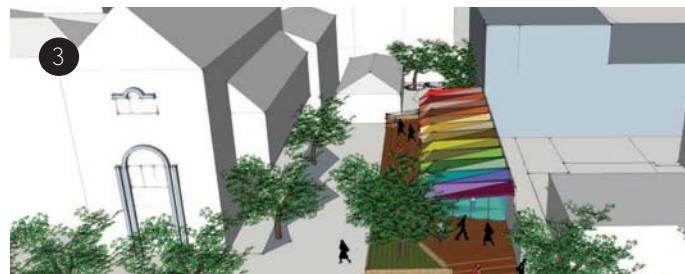
The competition invited entries from both design professionals and students and I thought that responses from each sphere were equally impressive. At a personal level, I had the pleasure of observing and reviewing under-graduate competition work in one University being undertaken as part of their course work. Their deep thinking and creative design processes were a delight to witness. I observed student responses that involved:

- serious consideration of contemporary education pedagogy;
- creative exploration of modular construction;
- appreciation of the importance of both internal and external environments;
- thoughtful consideration of deployment;
- variety and flexibility;
- contextual considerations;
- environmental response; and
- all presented with exceptional graphic skill.



2] A good example of a systems approach where manufacture, deployment and constructability are well-considered.

Design and image by Eu Ric Thor and Meng Hng Ho



3] A simple idea that could be carried through to an all-of campus condition, impressively presented.

Design and image by Ayrine Kwan



4] A deceptively simple idea yet a very effective and feasible prefabrication approach which supports modular expansion.

Design and image by Lauren Wheaton



5] A clever response from a secondary school student which promotes multiple uses within a simple, organic module.

Above: Design and image by Olivia Baenziger

“Competitions... this one has demonstrated a myriad of possibilities for the future...”

Summary

The *Future Proofing Schools Design Ideas Competition* was an ideas based initiative and it delivered in abundance on that objective. All participants in the initiative - the Melbourne School of Design and the Future Proofing Schools Research Team at the University of Melbourne, the Australian Research Council, the sponsors, the Linkage Partners, the jury, the winners and all the submitters - all of them should be congratulated for their participation and commitment to the initiative; more importantly, they all should be praised for their contribution to the broader conversation in seeking to improve, enrich and enliven such an important yet ignored element of our education landscape.

Where to now?

And so, where do we go from here? No ideas competition can lead directly to implementation - they're not intended for that - but this one has demonstrated a myriad of possibilities for the future. I feel that the most important outcome has been that the competition has opened the focus and discussion onto ways to improve a critical part of the physical education landscape: the humble relocatable. But I think the really important next step is the discussion that now needs to occur between the designers and the educators, the suppliers and the manufacturers, the authorities and Departments.

In the competition, the first step has delivered a re-imagining of relocatables and has offered tipping point possibilities for their design. The next step is collaboration between all parties to re-define the relocatable to ensure that the real progress can be made in the evolution of the relocatable into a more valuable tool that supports contemporary learning and teaching. For it is only with the collaboration of designers, educators, departments and manufacturers that the real progress can be made in this delivery model.

03

Lessons for the future

by Sarah Backhouse

The *Future Proofing Schools Design Ideas Competition* presented a complex challenge. We demanded a lot from our entrants.

Our brief sought ideas that explored not only the *physical* but also the *temporal* and the *cultural*. We invited entrants to propose a generic design idea, adapt it to a particular location, and then re-adapt it to another context. *Transferability* was required from one climate zone to another, from one physical and cultural context to another, and from one pedagogical style to another. The challenge was to explore how such issues could be better tackled in the future.

Analysing and reflecting on the ideas contained within the competition entries is a step forward in catalysing such change. Since the announcement of the Competition Winners in December 2011, the process has been to interrogate the submissions to see how they responded to the brief. This has been undertaken using both quantitative and qualitative measures.

Not only is the analysis of value in itself; it also demonstrates that we value the content and thinking behind all the submissions.

**“Perhaps most interestingly...
...only 47% of entries explicitly addressed how they would deal with relocation!”**

Analysis Overview

As researchers it is useful to see the themes, the areas of innovation, the ideas for ‘quick ‘wins’, and the ‘gaps’ within the competition entries. Some gaps have been unexpected, the most notable of these being in the areas of sustainability, new learning modes, and the impact of new technologies in the classroom. In particular, a number of entries appeared to overlook certain elements of the brief in favour of a more in-depth exploration of their prefabrication approach.

Yet the nature of an ideas competition is to explore and inspire without needing to resolve or address specific detail. So while entrants may not have explicitly addressed certain themes, these issues may have been considered during the design process.

The 119 competition submissions propose a wide range of approaches, and a number of these offer surprising and delightful solutions which resolve the complex brief at a range of levels. In the following pages we profile ideas contained within a selection of submissions to highlight the salient themes and opportunities for the future.



Key Findings

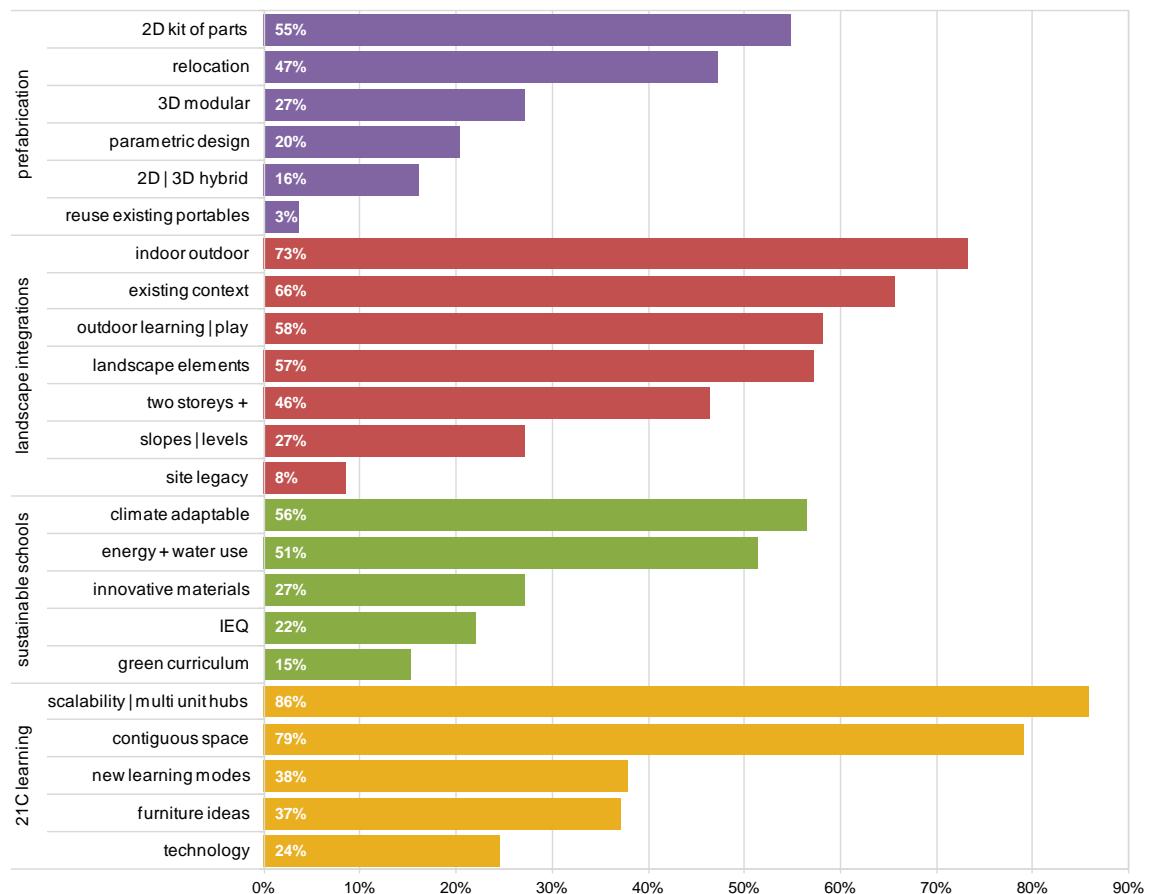
A quantitative interrogation of each entry assessed if they had *explicitly* responded to the strands of the brief or not. Some revealing headlines from this process are:

- 55% proposed ‘kit-of parts’ solutions;
- 27% proposed 3D modular solutions;
- 86% explored provision of contiguous, scalable space;
- 38% demonstrated an understanding of the impact of new learning modes on design;
- 51% incorporated energy and water use into their ideas;
- 3% explored the reuse and adaptation of existing relocatable classroom stock;

and perhaps most interestingly:

- only 47% of entries *explicitly* addressed how they would deal with relocation.

The Design Ideas Competition entries have highlighted valuable lessons, those for re-imagining the relocatable classroom of the future and those that may help improve current stock.



Rejuvenating existing relocatables

Given the large number of relocatable classrooms currently in use, ways in which they can be adapted and improved is of key interest to infrastructure managers.

Although it was not part of the Competition Brief, a small number of entrants chose to explore the re-use and adaptation of this existing stock. The following is a sample of opportunities that have emerged.

Parasol roofs over existing relocatables

Addition of a secondary ‘parasol roof’ has a number of key benefits which include:

- decreased energy use as the parasol roof reduces the heat load on the building below;
- decreased maintenance as the buildings are protected from direct sunlight and weathering;
- increased stock longevity, as a direct benefit from this weather protection;
- localised roof angles to harness greatest solar energy.
- increased covered space for learning and play;
- potential of an enhanced aesthetic.

Exploiting the parasol roof for both climate control and creation of an outdoor learning environment.

1] Design and image by Lisanne Havinga



Parasol roofs are well suited to hot, arid, humid climates yet could also have a transformative effect in other contexts. For example, parasol roofs would be an important ‘first step’ in the following upgrade strategies by providing protection of the existing relocatable during modification works.

Staged upgrade of existing relocatables

The steel frames of most relocatables allow for a range of ‘interventions’ without compromising structural integrity, such as the replacement of internal or external wall sections with other components.

Add-on modular components: These could ‘slot-in’ within the frame to modify and extend the finite rectangular forms, or act as connector elements between two relocatable classrooms. They could be generic or purposeful, perhaps containing wet-area zones or technology intensive media labs. Similar strategies could be applied to cladding panels to improve aesthetic appeal and performance of relocatables.

Indoor outdoor connections: External wall panels

could be replaced with sliding, folding glass or lift-up panels that connect to new external deck areas. This would help alleviate a common problem when the class bell rings and 25-30 students converge on the pinch-points of a ramp then a single leaf door.

Landscape components

Creating a menu of ‘landscape components’ should be as important as developing a similar menu for the classroom interior. Landscape components could range from add-on decking elements, water tanks, shelter trees and play elements.

Water

Relocatable classrooms are generally raised above the ground to allow for connection of services and ventilation. There is an opportunity to use this sub-floor or sub-deck space to integrate either rigid or bladder membranes for water capture.

Covered Playspace

There is an opportunity to raise relocatables to provide covered play space below. Whilst this creates challenges in terms of accessibility, there will be some school contexts where this can be achieved.



Active walls for active kids proposes to elevate existing relocatables to create a play ‘undercroft’ below. Although issues around access require further resolution, the core idea has interesting potential.

3] Design and image by David Mitchell

Chrysalis explored a secondary roof design that could be used to upgrade existing relocatables, be integral to future approaches, and also act as landscape components.

4] Design and image by Codessi Architects

Examples from Competition Entrants

The Generative Adaptor was one of the design ideas that explored ‘staged upgrades’ to the building fabric. With two simple steps an outdated teaching environment could be transformed, ready for the 21st century:

- step one involves the installation of a parasol roof that creates new external play space and improved environmental performance;
- step two involves the insertion of new modules to extend and redefine the space for 21 century learning.

Such strategies could be appropriate to a wide range of physical contexts.

2] Design and image by Stephen Clement and Michelle Dunas



Strategic ideas for the future

Competition entrants imagined how we might *future proof* our learning environments in a design-led and agile manner. We highlight a sample of the more strategic opportunities for the future.

Challenge the ‘Box’

There was a strong trend of challenging the ‘box’. The use of factory built modules need not limit us to a simple rectangular building. Entrants demonstrated that a rich variety of spatial arrangements are possible, showing that applying a more ‘additive’ approach to a simple base module can provide infinite configurations.. They also explored the creation of scalable and contiguous spaces.

Product Families

Many design ideas explored the development of ‘product families’ of interchangeable components, allowing a learning environment to be ‘mass customised’ for one context, then adapted for a future location. Competition entrants proposed an interesting menu of both indoor and outdoor learning settings for the education sector. Interchangeable product families would also mean that certain elements of a building could be substituted in the

The *Porti-Lab* takes a strategic approach by providing quick access to innovative settings in an ever changing technological, physical and learning landscape.

5] Design and image by Ashley McFarlane



future as needs change or technology advances.

User Interface

The role of user engagement in the ‘mass customisation’ process captured the imagination of designers, facilities managers and educators alike

Working from a finite menu of pre-costed elements, a school community would be able to ‘pick’n’mix’ components to define their own learning settings be it through a community consultation process or a computer ‘app’.

Contextual Integration

The ideas for mass customisation explored how prefabricated learning environments could be adaptable to local contexts, taking into account climate, landscape integration, and aesthetics. Design ideas explored far greater visual connection and physical movement between indoor and outdoor learning environments, proposed external walls that ‘dissolve’ in appropriate climates, and outdoor classrooms that are as important to learning as the indoor classroom.

Permanent quality and relocatable, or not

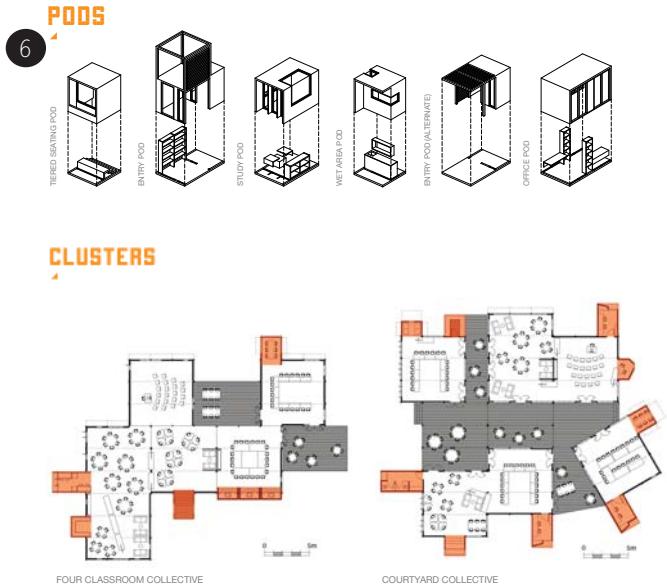
Although the focus of the Competition was on relocation, there is an opportunity for the education sector to make greater use of prefabrication generally. In the future a large number of our educational buildings could be prefabricated and delightful, designed and built to a ‘permanent quality’, yet with the possibility of being relocated in the future if need be.

Generic or specialist

At a strategic level, relocatables may also be considered differently in the future. Rather than offering additional ‘generic space’ as they often do today, relocatable infrastructure could be used as a test space for new technologies or pedagogies.

Design

There is enormous potential to transform relocatable classrooms so they become exemplar spaces that are *proudly* located within the school context. Good design is a critical element of this transformation.



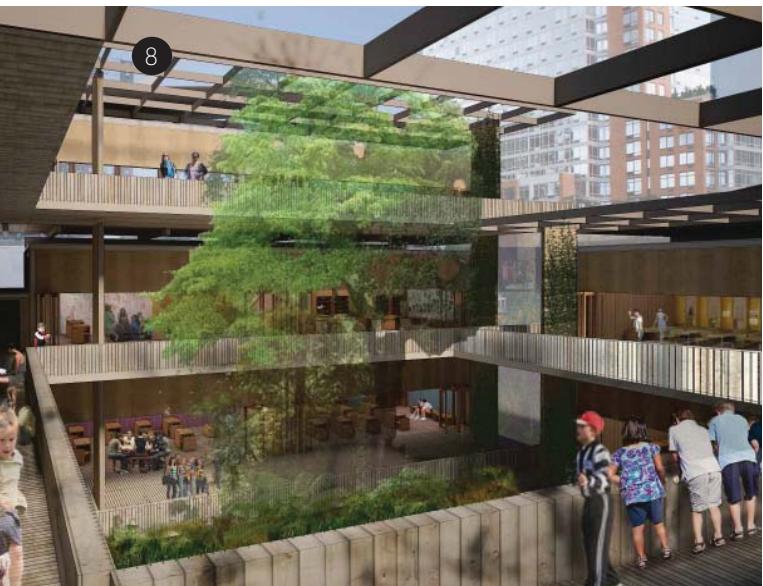
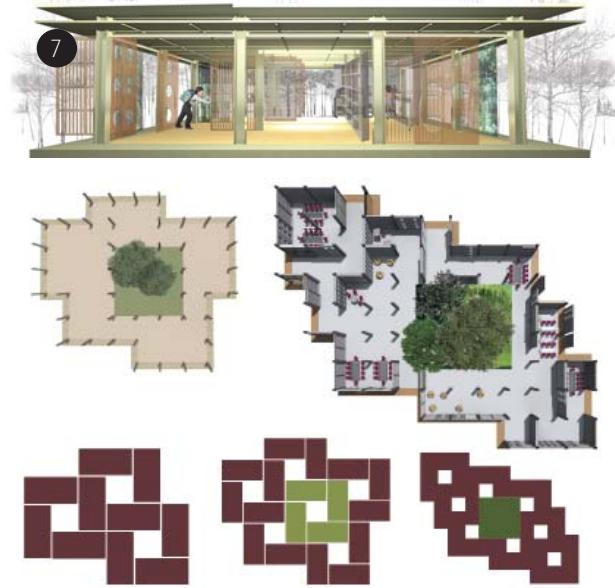
Examples from Competition Entrants

A rectangular base module need not constrain potential configurations, as skilfully demonstrated by a number of design ideas.

Two interesting examples are *Prototile* (see left) and *Push Play Learn* (see right).

6] Design and image by Williams Boag Architects

7] Design and image by Chriss + Chen Design

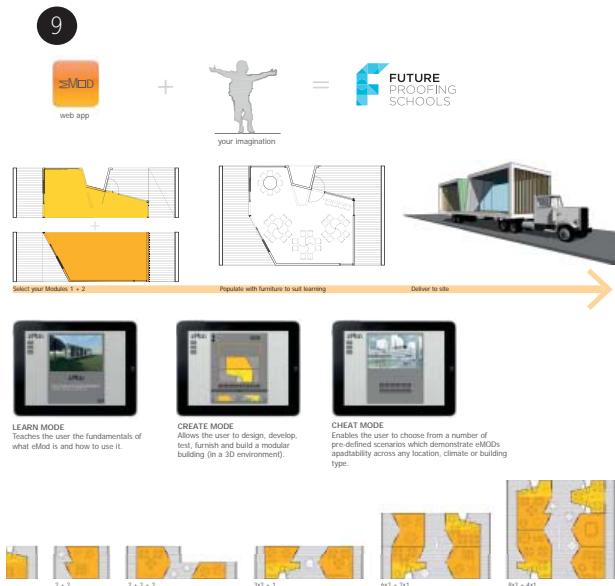


Interchangeable product families would allow for more agile responses to localisation of a school and adaptation or upgrading over time. Such a strategy need not be limited to 'relocatable' buildings as demonstrated by a large number of design ideas.

8] Design and image by Dowling Architects with Shift Landscape + Urbanism + Strategy

The *eMod* is a deceptively simple and clever idea. From a starting point of two base modules, a vast number of configurations are possible. User group participation in the design process would be facilitated by a computer 'app' (see right).

9] Design and image by Architectus Melbourne Pty Ltd





04

A touch of class, but not as we knew it

by Susan Wilks

Introduction

I read with interest the figures that emerged when Sarah Backhouse quantified the extent to which each of the *Future Proofing Schools Competition* entries had addressed or responded to the content and tipping points four research strands – ie 21st century learning, sustainable school environments, landscape integration and connections, and prefabrication & mass customisation (See *03 Lessons for the Future*). As an educator involved in the *Future Proofing Schools* project my interest was in innovative **21st century learning** with its emphasis on collaborative learning, big ideas, problem-based learning and critical and creative thinking and, of course, the learning spaces that supported this model of learning.

Although **indoor/outdoor connections** are rarely present in traditional school settings, most BER-enhanced and newly constructed schools have addressed this factor and students are known to love learning outdoors. Teachers are just beginning to consider using outdoor spaces for learning activities and need encouragement to expand the spaces they inhabit into the outdoors. It was particularly pleasing to see that three quarters of the competition entrants included this aspect in their designs and presentations.

Although sustainability issues form a major part of today's curriculum, there was an extremely low presence of statements about 'green curricula' (15%), indoor air quality (22%) and innovative materials (27%). Further, the fact that less than half the entrants had addressed 'new learning modes' or included innovative (if any) furnishings – at least explicitly - caught my attention. I noticed that relatively few entries contained illustrations of interiors and spaces with occupants (ie students

and teachers) or spaces containing variously configured furnishings. Many entries contained traditional chairs and tables or desks in rows even if the spaces were exciting, non-rectangular and/or contiguous (and 79% were contiguous).

In another 2011 research project in which I participated as a Melbourne University partner, over fifty children and young people were interviewed about learning and learning spaces. They revealed that they:

- have a deep and broad understanding of what 'learning' is
- think learning opportunities require fun, games and interactivity in order to engage
- are social beings and learning opportunities should reflect this
- want activity rooms and outdoor spaces that provide social interaction
- want appropriate furnishings and choices about fit outs of activity rooms and recreation spaces
- are capable of being included in decision making about their learning and learning spaces

As my area of interest is in innovative **21st century learning** with an emphasis on collaborative learning, problem-based learning and critical and creative thinking and, of course learning spaces that support this model of learning, I would like to explore four Future Proofing Schools Competition entries as examples that, according to the team analysis, rated well on all four of the project's research strands and offered innovative, appropriate and exciting 21st century learning spaces.

Four innovative entries

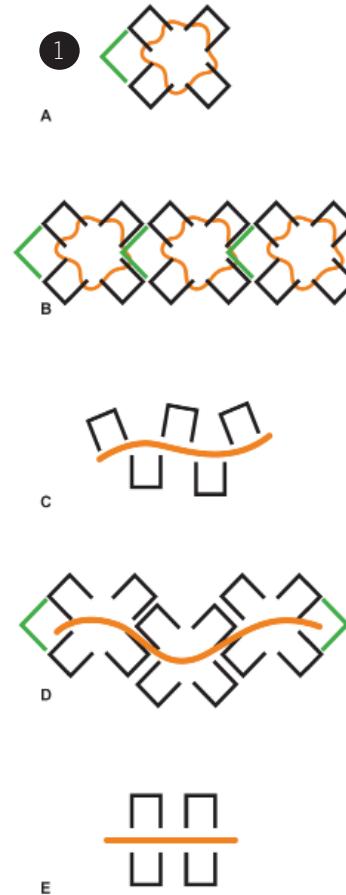
During both this and earlier projects conducted by the Smart Green Schools team many teachers have been observed working in traditional and moving into new learning spaces. We have interviewed many about their experiences in spaces, the role of technologies and equipment, and what works well. I believe the following four responses catered for both teachers' oft-stated requirements and students' wish lists.

1. ModuPOD by NBR&S + Partners

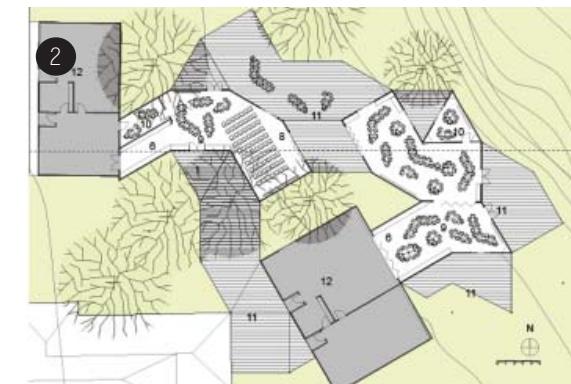
The dynamic Modupod clusters support rather than impose modes of learning and offer collaborative, experiential learning possibilities through the subtle spatial clues that are created by seamless environments. The fact that the system is flexible and configurable eg cluster, linear, stack, campus producing multiple student centred zones – means it can support an evolving pedagogy and various site conditions and climates. The materiality that provides lights, ventilation, solar access and shade control occurs through various layers of screens.

2. Machine for Learning by Enza Angelucci Architects

In all three strategies, the positioning of staff facilities maximise accessibility and surveillance. Learning, cultural and social factors are considered in the provision of both large and intimate spaces. As well, reflecting students' desire to be included in decision-making, the strategy "skin" is only partly prepared off-site. This allows for both students and community to have input into the provision of further exterior skins - given local council support.



1] Professional Competition, ModuPOD: Design and image by NBR&S + Partners, Sydney



2] Professional Competition:
Machine for Learning -
Design and image by Enza
Angelucci Architects,
Melbourne





3] Design and image by University of Melbourne Student Ayrine Kwan

4] Design and images by University of Sydney students Mingze Sun, Xing Gao and Shang Gao



3. Half short, half long and one and a half by Ayrine Kwan

Ayrine Kwan's design catered for integration, connection and sustainability, the staple requirements of 21st century learning spaces. The connection between indoor and outdoor spaces occurred through the decking and undercover verandahs that provided shade and prevented direct sunlight from entering the learning spaces. This allowed for outdoor learning and invited community use. The strong indoor/outdoor connection would encourage teachers to use both areas and meant students would see the environment, as well as work outside on their projects or in the vegie patch. Windows could be opened manually by occupants and allowed night purging.

4. The L Box: Learning, Leading, Lasting by Mingese Sun, Xing Gao and Shang Gao

The L Box encapsulated young people's requirements for learning spaces to be fun. These young designers (Mingese Sun, Xing Gao and Shang Gao) injected whimsy and exciting possibilities into their demountable design. Based on simple rectangular and square forms the modules could be repeated with different orientations to expand and grow according to different design principles – linear, centred, dispersed or courtyard. The module could be rotated 90 degrees vertically or horizontally (where the plan became the section).

If we excuse the young designers' oversight of not providing railings on stairways, the L Box certainly looks like a fun place in which to teach and learn.

05

Landscape integrations in space and time

by Jacqui Monie

The Landscape: Integrations & Connections chapter in the FPS Phase 1 Research Compilation provided a brief for entrants on best practice school landscape design and the integration of internal and external space.

As a research team we sought to position the school landscape firmly on the agenda and at the beginning of the process of rethinking relocatable classrooms. We also highlighted the potential for a well-designed relocatable classroom to create, define and transform outside space, and the experience and use of that space.

The competition elicited numerous innovative and delightful design responses that beautifully illustrate



the concepts outlined in this landscape ‘brief’ in ways that have been rarely found in association with relocatable classrooms, in Australia or elsewhere. A large number of these design ideas, whether explicitly or implicitly, embody a real consideration of the value and contribution of landscape integration and outside spaces in formal and informal learning, play, development, comfort, health and reducing stress levels, among other benefits.

This article captures and celebrates these design ideas, and uses the illustrations to revisit and reflect upon the key aims for landscape integrations and connections, in terms of both space and time.

1] Chrysalis: Rana Abboud & Ewen Wright (CODESSI)

Landscape integrations in space

What is ‘landscape’? In simple terms, the school landscape could be considered to be anything beyond the walls of the classroom. However, the relationship between buildings and outside space is more complex: the landscape is experienced from within the classroom, and likewise a classroom (or configuration of multiple classrooms) has a critical influence on the shape, dimensions, quality, use and experience of the spaces that surround and connect to it.

The landscape associated with a relocatable classroom therefore goes well beyond providing a few landscape elements on the outside of the building after it arrives on site, as is generally the case in the

deployment of relocatables in Australia (if at all): adding a garden bed, some mulch, a path or some seating, for example. This does little to soften the visual impact of the building, or to provide the kinds of outside spaces that nurture the development of young minds and bodies.

The design ideas featured in this article illustrate these spatial relationships and the possibilities for future relocatables, focussing on their placement within landscapes, the kinds of outdoor spaces they create, and how they provide for physical and visual connections between in and out.

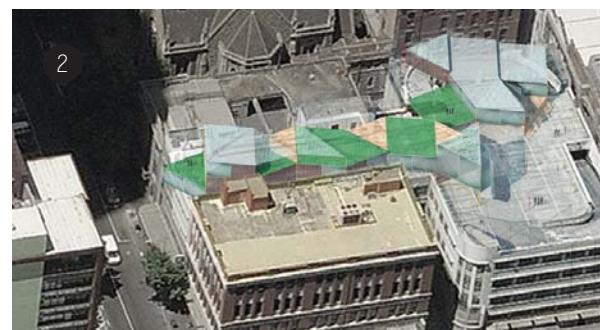
Landscape integrations in time

If there is to be spatial integration between school landscapes and relocatables, these objectives must also be integrated in terms of time. If landscape is seen to be important and integrated at the beginning of the design process and in planning the siting and arrangement of relocatables at a school, then effective and delightful outside spaces can be created by the building design. They can also be created by the careful arrangement of buildings in relation to each other and the existing infrastructure of the school. Conversely, if landscape is not considered at the beginning, it can be difficult to later adjust a design, retrofit a building, or change the way buildings are arranged on a site, in order to create good outdoor spaces and in-out connections.

Many of the best design ideas emerging from the competition integrated the landscape and site context from the beginning. These ideas 'set up' the outdoor

spaces and the spatial relationships so that even upon the arrival of the relocatable at a school, useful and delightful outdoor spaces would be created. These spaces can then be further improved over time, with vegetation that will mature and change, or with other landscape elements (shelter, seating etc.) as budgets permit. Given the temporary nature of relocatables, there is often little or no budget left over for things that are considered 'extra', including landscape improvements. The early consideration of landscape can mitigate this to some degree.

The notion of integrating the landscape into the design and siting of relocatables over time also encompasses thinking about the landscape as dynamic and ever-changing, and something that the students and the broader school community can influence, particularly given the less formal status of relocatables. Over the life of a relocatable, whether left in place or relocated, new needs and pedagogies will also emerge that are currently unforeseen, and



2] Machine for Learning: Enza Angelucci Architects. This design idea challenges us to rethink 'landscape', and shows that even an inner city rooftop can be a landscape.

the outside spaces need to be flexible and diverse enough to provide for these. A number of competition entries addressed these challenges.

The competition: a technical analysis of landscape integrations and connections

In addition to the jury assessment of the competition entries, the research team assessed each entry according to how well it responded to the brief. Seventeen per cent of all entries received a very high score (of 80% or higher) in a technical analysis of how well they had addressed the landscape brief. A smaller number of these entries were quite exceptional in the way the landscape was integrated and central to the design idea.

The most successful of these design ideas embraced the concept of integration, whether intuitively or in response to the brief. The most successful in this respect were those that holistically addressed the design challenge set by the competition. These design ideas integrated their solutions to provide for new ways of teaching and learning, building and landscape sustainability, integration with the existing landscape and newly created outside spaces, while also providing for prefabrication and relocation. When brought together, it becomes clear that each element is critical for providing delightful spaces in which to teach and learn. Landscape plays a key role.

This article captures some of these design ideas, to demonstrate some wonderful possibilities for landscape integrations and connections in future learning environments associated with relocatables.

Placing relocatables within school landscapes

Relocatable classrooms in Australia are mostly raised off the ground for ease of relocation and access to services. However this generally results in utilitarian footings and access between the floor level and the ground, which does little to integrate the building into its context.

A number of design ideas provided generous decks, ramps and stairs, creating a progression from the building to the ground that anchored the relocatable to the site and made the building itself a part of the landscape, rather than appearing like an unwelcome visitor to the site. At the same time, this infrastructure created plenty of options for sitting in large or small groups, provided diverse surfaces for play, and enabled outdoor space to be used in a diversity of ways, in both structured and unstructured learning and play.



3]



3] Burgeoning Box: Carste Studio - Katrina Goddard, Stephen Booker & Elizabeth Evans
4] Arup + LAVA

Maximising play space and fitting relocatables into tight sites is a key design challenge, which was addressed by almost half the competition entries through proposals for stacked or multi-storey relocatables. Around a quarter of entries dealt with sloping sites, or raising the building above the ground to provide sheltered play space underneath or to protect the building from flood.

In inner city Melbourne these ideas are particularly timely, with some schools becoming cities of relocatables. For example, in Port Melbourne Primary School, 14 relocatables already cover one third of the school's play space, and with 90 new enrolments each year the relocatables are threatening to take over all the entire school grounds (Leader Newspapers, 17 April 2012).

Connection to the ground



5]

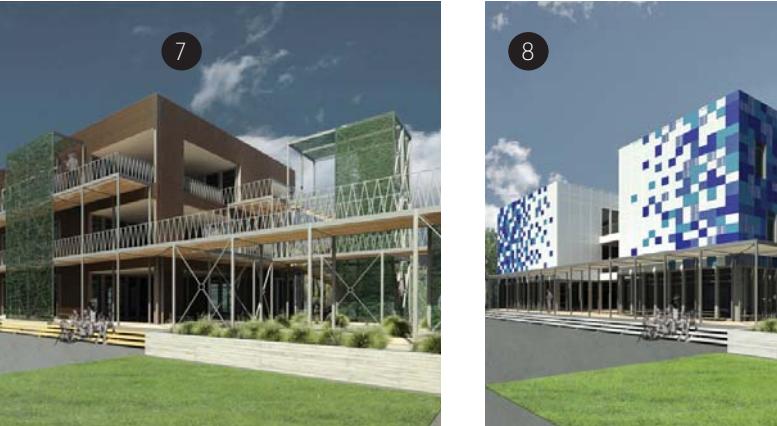
5] Amy Ang, University of Melbourne

Stacking, vertical placement



6]

In addition to making better use of finite playground space, a multi-storey building is inherently more permanent-looking than single, detached classrooms. Relocatables that can be stacked vertically can also provide a much quicker response to fluctuating enrolments than planning for new schools in dense urban areas.



7] 8] 9] miClass: Ashton Wright

6] Shao Ing Gan, Mark Walker & Corinne Trang.
‘Classrooms shape and define adjacent outdoor spaces. Roofs projecting beyond the walls provide undercover external spaces. The nook area allows for open and closed configurations that blur the boundaries between outside and inside. The walls and pivoting surfaces in this area allow students and teachers to fine tune ventilation, light and views.’

10] Mount It: STUDIO LS Ruimtepraktijk



Connection to existing school infrastructure

Creating and siting well-designed relocatable classrooms that appear permanent in the landscape can help in reversing their negative stigma. A number of design ideas achieved a sense of permanence in the way they connected the floor level to the ground plane, and connected to existing school buildings and infrastructure.

Others achieved this simply by designing relocatables that didn’t look like relocatables – they appeared to be permanent and of permanent quality.

11] Burgeoning Box: Carste Studio - Katrina Goddard, Stephen Booker & Elizabeth Evans.

‘The integration of the BOX with the landscape of the school gives the facility a degree of permanence, separating it from the stigma of existing transportables.’

12] Arup + LAVA

‘...allows the future classroom to adapt to multiple sites, unusual configurations and topographies.’

The best design ideas also showed the new relocatables in context (in a real or hypothetical school), connecting them to each other and to other school buildings. Instead of putting them at the back of the school to simplify relocation and access to services, the buildings were often set amongst the existing school buildings. Sheltered corridors, paths, garden beds and other connecting infrastructure was often provided.

This connecting infrastructure can visually and physically tie the relocatables into the existing built fabric of the school, again making the relocatables appear more permanent and defining new outdoor spaces within the school landscape.

More than half of all entrants proposed separate landscape elements as a part of their design idea – shelter, decks, planter boxes, drinking fountains and other elements that match the design of the relocatable, which would help to tie it into the school context.

Creating a sense of permanence



Moving and looking in and out

The majority of existing relocatable classrooms in Australia, new and old, have poor connections between in and out, both physically and visually. Narrow entries, ramps, stairs and decks create bottlenecks and prohibit the opening up of the classroom to the outdoors. Windows are often too high for small children or those seated at desks to see out, and buildings are raised above the ground, further disconnecting the inside from the outside space.

Blurred Boundary between in and out

13



13] Chrysalis: Rana Abboud & Ewen Wright(CODESSI)

Some of the best design ideas addressed these issues by blurring the boundary or providing intermediate spaces between inside and outside, and allowing free movement to the outdoors. These designs acknowledged the importance of the outdoors in learning and play, and supported new ways of teaching and learning which calls for more diverse and flexible internal and external spaces and arrangement of space, including the ability for a class to flow between inside and outside.

14



14] PackAdaptable: i2c Design and Management & Aurecon
 ‘Students do not touch, hear or see passively. They feel, look and listen actively. We invite students to interact with the building form and function. Students watch and listen as the translucent bladder fills with water. Dappled light plays on surfaces as the vegetation covers the open frame for shade during the warmer months and let’s light through during the cooler seasons.’

15



Flows between in and out

16



15] C3: Classrooms, Connections, Communities: Lauren Wheaton, University of Melbourne

16] GREEN Pack+SMART Pack: dKO Architecture and AECOM
 ‘Based on the individual configuration, the SMART Pack provide many options for spaces to intertwine with each other where there are opportunities to flow out from an enclosed space to a deck or a sandwiched deck between classrooms will be informally converted to gathering and alternative learning space.’



Intermediate spaces

In some designs, intermediate spaces between inside and outside, or large sheltered spaces outdoors, provide substantial areas for structured outdoor learning, particularly in warmer climates. What if formal classrooms could be reduced in size, with the cost savings put into this less intense infrastructure as a part of the landscape?



17] Click-Learn: Chris Moller Architecture + Urbanism, Studio Engleback, Urban Puzzle Ltd, blue pencil & e cubed building workshop limited

The landscape strategies are based on traditional techniques, natural systems generate airflow, modify temperature and habitat for a rich learning landscape eg edible walls and kitchen gardens integrate internal/external learning from nature.

19] Mode Design. ‘Open plan, naturally lit and ventilated teaching environments with direct access to the outdoors’

20] miClass: Ashton Wright



18] Eu Ric Thor & Meng Hng Ho

Visual connections to the outdoors

The value of providing clear views to the outdoors was recognised in a high proportion of the design ideas – connecting students with the landscape and the world beyond the classroom. This was often achieved in full length glazed doors, which provide for both visual and physical connections.



Creating outside spaces

The external design of a relocatable makes a significant contribution to the landscape. For example, the form of the facade and the arrangement of relocatables on a site define the shape and size of the adjoining spaces. The visual and physical permeability of the building affects how public or secluded the adjoining space feels. Verandahs or seating nooks affect the level of comfort and the diversity of the outdoor spaces and how they can be used.

A facade can also contribute to a sense of delight in the adjoining outdoor spaces, a key aim for the design ideas competition.

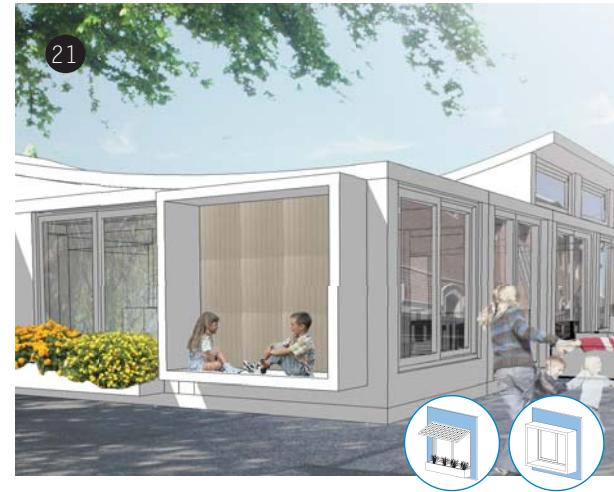


Delightful, interactive and playable facades



25] Mount It, STUDIOOLS Ruimtepraktijk

21] Nest Architects



Some of the most innovative designs provided delightful facades that introduce colour and interesting building forms into the school ground. Others were interactive, allowing students and teachers to change the facade to open or close it to the outdoors, or to provide different levels of light and shade. Some created building exteriors that were playable, becoming an integrated element in the school play space. Almost 60% of entrants provided for outdoor learning and play, with many also utilising the building as an active participant.

22] Ayrine Kwan, University of Melbourne

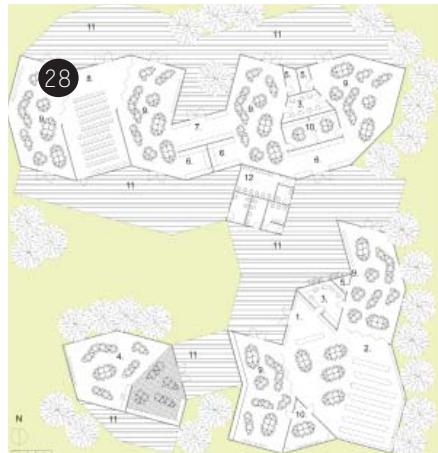
23] Click-Learn: Chris Moller Architecture + Urbanism, Studio Engleback, Urban Puzzle Ltd, blue pencil & e cubed building workshop limited

24] GREEN Pack+SMART Pack: dKO Architecture & AECOM

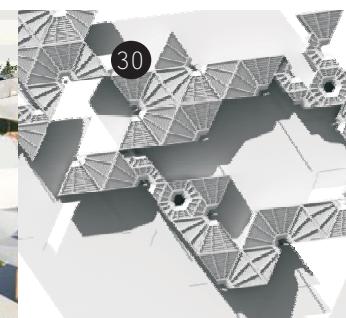
26] Chrysalis: Rana Abboud & Ewen Wright (CODESSI)

'Planters designed into the verandahs of the Chrysalis provide outdoor seating, and climbing plants gradually cover areas of the facade, allowing the relocatables to visually 'grow' into their surrounding environments.'

Providing flexible and diverse space in schools, where the functions are not defined, can create the most possibilities for formal and informal learning to take place. Some of the top designs showed configurations of buildings that created diverse outside spaces in terms of shape, size, function, levels of openness/enclosure, and connectedness to the indoors. Some design ideas effectively brought the landscape indoors, with indoor plantings and internal courtyards. Two thirds of entrants looked at how their design idea would be integrated into specific real or hypothetical school landscapes.



Arranging buildings to create diverse and flexible spaces



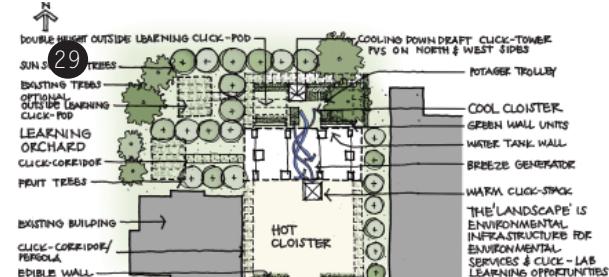
- 28] Machine for Learning: Enza Angelucci Architects
- 29] Click-Learn: Chris Moller Architecture + Urbanism, Studio Engleback, Urban Puzzle Ltd, blue pencil & e cubed building workshop limited
- 30] CoolSchool: Anastasia Globa, Victoria University of Wellington



27] Dowling Architects. 'Interior and exterior areas are co-dependent and considered a continuous landscape for kinesthetic learning. Surfaces and niches allow choice for material, texture, colour and planting.'

31] Podulation: Jennifer Yang, Carol Yan & Demetri Demetriou, University of Melbourne.

32] GREEN Pack+SMART Pack:dKO Architecture & AECOM



Enclosing spaces and bringing greenery inside



A key opportunity for creating outside spaces with relocatables may also be in terms of allowing for more free-form, messy spaces, where the students are actively engaged in the physical form and functions of the space, exploiting the temporary status of the building and its relative lack of formality. Designers of relocatables can provide the framework within which this sort of engagement can occur – creating a situation where the learners and teachers are encouraged to participate in their environment, to complete or to continually/incrementally change the space.



Design and image by Calder Flower Architects

The Big Picture

06 The Secret Life of an Infrastructure Manager

by Lena Gan and Clare Newton

07 Temporary but Not!

by Lena Gan and Sarah Backhouse

08 Innovation Opportunities

by Clare Newton

06

The Secret Life of an Infrastructure Manager

by Lena Gan and Clare Newton

The degree of difficulty faced by school infrastructure managers cannot be overestimated. They work within the constraints of limited government funding to ensure that children across Australia have comfortable and effective learning environments. They manage emergency classroom provision after fires, floods and other unplanned events. They deal with the uncertainties of school enrolments responding to changing year-by-year student numbers and longer-term demographic changes. They provide accommodation to suit diverse built, cultural and climatic environments in remote areas, rural communities as well as tightly built-up urban areas. They are required to make judgements on value for money and life-cycle costing such as whether a current investment in sustainable technologies will pay off over the life of a building.

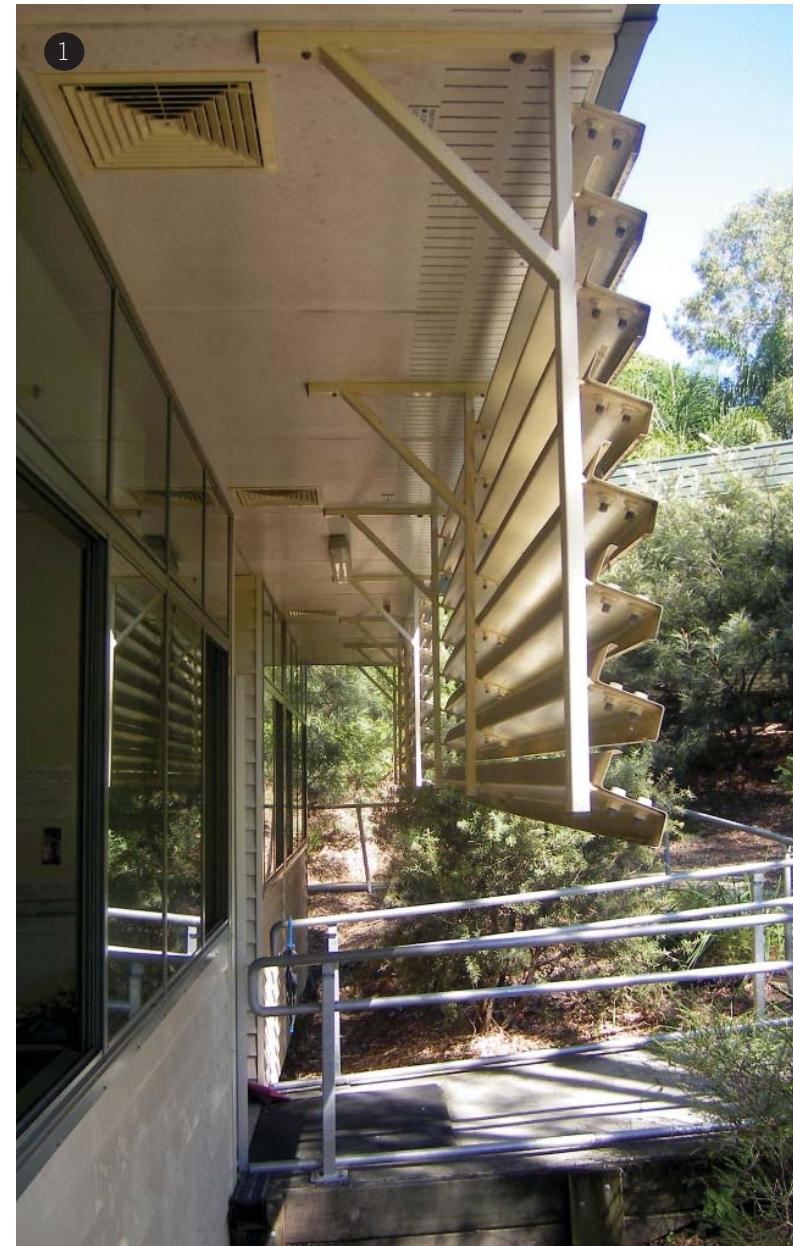
Within this context, prefabricated relocatable buildings play a vital role but bring their own logistical difficulties for infrastructure providers. Relocatable buildings require a different brief to a permanent building in terms of weight, footing construction, size and materials. This brief has meant that relocatable classrooms have tended to be viewed as second rate

largely because of their lightweight nature compared with permanent buildings.

Infrastructure managers have specific drivers and priorities in terms of prefabricated classrooms determined by the strategic provision of education infrastructure across an entire state or diocese. This report brings together an overview of the issues, drivers, priorities and variables that shape infrastructure management approaches to relocatable, prefabricated classrooms.

Prefabrication as a useful infrastructure choice

Education departments have used prefabricated classrooms for decades as a quick and cost effective way of dealing with shifting demographics, remote communities, when additional classrooms are needed due to building works or emergency situations such as fires, storms and floods, and for special purpose schools. This purpose of fulfilling a short-term need has led to their being unapologetically utilitarian in construction and design. This utilitarian form is largely the result of their being mass-produced for transport even though they are required to function in a wide range of climates, locations and contexts.



Despite their relocatable designation, many of these classrooms become permanent fixtures in school grounds.

There are a number of reasons for prefabrication being a good option for school infrastructure. These include: cost savings through economies of scale, speed of manufacture and delivery, controlled delivery, consistent quality, minimal site disruption, construction unaffected by weather, no need for specialist local labour, can be relocated to suit demand, uniformity of size and a solution for remote sites. *"I already believe that off-site construction will be the way of the future. We already have a significant skills shortage, and young people are not taking up apprenticeships."* [Infrastructure Manager]

1] Sun Shading, Buranda Primary School, Qld



Infrastructure drivers

There are a number of key drivers linked to an infrastructure manager's mandate of providing sufficient learning spaces in a timely and cost effective manner for every child who wants to go to school. These include:

- Cost - value for money
- Demand - changing demographics
- Transport - installation and life span
- Environmentally Sustainable Design – must meet Department standards
- Variations in climate, site and regulations - must function in different locations
- Comfortable and effective learning spaces

2] Primary school classroom, NSW

A] Cost – value for money

We list cost as the first constraint driving the design and construction of relocatable school buildings. Infrastructure departments work with limited government budgets and there are pressures to provide a quantity of space even though there is a desire to provide quality of space. Decisions regarding life-cycle costing need to be made. Upfront costs for sustainability initiatives are considered in the context of energy savings over the life of a building. Discussions of costs do not include the less tangible benefits that buildings provide. High quality environments send a message to students, parents and teachers that education is valued by governments and communities.

With office buildings higher costs for green buildings are increasingly considered not just in terms of life-cycle energy savings but also in terms of market appeal and improved productivity of workers. Evidence which links student achievement in terms of building and indoor environment quality is particularly difficult to capture as a cause and effect because learning and schools are a complex system. What is easier to capture are the students and staff reactions to new, better quality school spaces.

"It's lovely and the air conditioning is fantastic. We've noticed the difference in the kids – they are so much more productive and do better work in the new space."

"The rooms are bright and airy... a nicer environment to be in. I've told them they're not getting me out – it would take a backward step going back to the old classrooms."

B] Demand - changing demographics

Schools are planned on the basis of a permanent core of school and community facilities, supplemented with relocatable, prefabricated buildings to respond to changing enrolments. For example, in Victoria the rule of thumb is around 80% core buildings and 20% flexible buildings although the reality can be quite different. Almost all schools will grow to a peak enrolment which is much greater than the opening numbers, and then drop back to a base number which in Victoria is typically around 450 for primary schools and 1,100 for secondary colleges. Prefabricated classrooms allow the Department to cater to shifting populations and changing demographics.

Departments forecast up to 25 years in advance. It is a complex process with data coming from a variety of sources such as the Australian Bureau of Statistics, independent reviews and local councils. For example, the Department in Victoria works closely with the Growth Area Authority (GAA) to identify where development will occur and develops a likely masterplan for those areas. The GAA does a lot of complex planning for new suburbs, overlaying the needs of many different groups including the Department of Education, Catholic and Independent Schools and tertiary institutions. This type of planning is designed to minimize the pressures on infrastructure and ensure the sustainability of new areas.

"One of the builders was saying that when they first set up on site, there was nothing for kilometres in all directions. Within six months



3] Decommissioned relocatable classrooms, Vic

there was so much development in the area it was amazing and by the time the school opened, it was a new suburb." [Infrastructure Manager]

C] Transport - installation and life span

Transport is a major and costly factor in the design of prefabricated learning spaces. There are significant and specific restrictions around dimensions and weight, possible transport route (road or river), availability of cranes and site accessibility.

"There are parts of the Northern Territory which can only be accessed by barge for around seven months of each year. This is a real challenge when providing infrastructure." [Infrastructure Manager].

As prefabricated classrooms are relocatable by definition, they must be able to withstand multiple moves over a lifetime of around 30-40 years. They must also be able to be readily installed in remote areas and in a variety of sometimes difficult site conditions.

D] Environmentally Sustainable Design

A common issue with past prefabricated classroom modules has been environmental performance in terms of energy use, air quality, thermal comfort, acoustics, chemical emissions and humidity. All departments of education now have mandates for infrastructure to be designed to meet environmentally sustainable criteria. Some prefabricated classrooms are being retrofitted with photo-voltaic cells, solar hot



4] Steeply sloped site, Qld

water and double glazing. New buildings may include automated ventilation with louvres and night purging systems, better insulation and a stronger focus on good orientation and shading. A recent exemplar prefabricated classroom called "envi" by DEECD in Victoria uses intelligent environmental control and monitoring.

One issue for infrastructure departments has been finding appropriate rating tools. The Tasmanian government recently committed to apply the Green Star rating system developed by the Green Building Council of Australia (GBCA) for their new education facilities. According to the GBCA there are currently 24 Green Star rated education facilities around Australia with a further 70 registered to achieve Green

Star ratings. Green Star is an expensive process and there has been comment that it is more suited to tertiary facilities rather than schools. In Victoria, the Department has developed its own guidelines which will be used until a more appropriate measure becomes available.

E] Variations in climate, site and regulations

Prefabricated buildings are located in diverse environments with regulations addressing risks such as cyclone, flood and fire. In addition, climates vary dramatically across the country with southern states requiring effective insulation against cold and tropical areas needing control of heat and humidity.

In the wake of the devastating 2009 fires in Victoria,

the bushfire codes included in the 'Victorian Building Regulations 2006' have been amended. Sites are given a Bushfire Attack Level (BAL) rating that determines the type of construction required and materials selected. The BAL takes into consideration such factors as the Fire Danger Index, the slope of the land, types of surrounding vegetation and proximity to buildings.

In northern Australia, buildings must be able to withstand cyclonic wind conditions to comply with the Building Code of Australia (BCA). Prefabricated classrooms must be bolted down securely. One primary school principal in Darwin commented on compliance requirements associated with the procurement of prefabricated classrooms.

"They have to be cyclone rated and the engineering reports alone could cost \$3,000 just for one classroom. Then you have the issues of fire control, safety with air-conditioning equipment and humidity controls to balance the airflow as they are independent units."

There are criteria around acceptable sites for prefabricated classrooms such as maximum slope of a site, proximity to services and the maximum amount of paving. Any variation from these conditions needs approval. Queensland has many challenging sites along the eastern seaboard with steep or undulating topography. In addition during the floods of 2011, the department of education discovered that it had 92 school sites that were flood prone. Previously only around 75% of these sites had been classified as flood prone.

"We haven't used double glazing due to cost. It is a challenge as you can get condensation on the inside walls, then damp and mouldy carpets and it gets into the air-conditioning system. Then there is mould on the classrooms tables and the kids get colds or sick and before you know it it's cost you \$100,000 in air monitoring systems, carpet being ripped up a couple of times etc."

[Infrastructure Manager]

F] Comfortable and effective learning spaces

Prefabricated learning spaces have a long heritage. In the last decade, education departments have been working with architects and schools to transform school designs to suit changing pedagogy, sustainability imperatives and access to new digital technologies. Prefabricated school buildings have not yet altered to the same extent. While the reasons are not straightforward, it may be partly because of the complexity of this kind of infrastructure which is so closely linked into a construction industry which is understandably risk averse.

"These things have recently been described as site sheds on steroids..." [Program Manager]

There is a high degree of awareness amongst infrastructure managers about the need for the visual appearance and design of prefabricated learning spaces to be improved. The lack of design has been partly attributed to the procurement process which uses a performance specification with no aesthetic requirement as the design brief.

As prefabricated buildings have not commonly been

designed for team-teaching, some schools take the walls out between the two classrooms in older double prefabricated models as an adaptation to their requirements. Others link classrooms together around a common covered space. One principal stated that to cater to the new pedagogies, "you would almost have to have one (*prefabricated classroom module*) with four rooms that are openable." Another new growth corridor school has built its curriculum around its new learning environment but the older prefabricated classrooms don't meet its requirements. This means that for part of the week, teachers must adapt their classes to old spaces that don't work for the new pedagogies. This is not to say that all prefabricated school buildings are still in classroom format. St Joseph's School in Mernda is an example of more open plan prefabricated school buildings designed as permanent spaces.

In conversation with principals, we found priorities for educators in terms of prefabricated classrooms differed from the priorities of infrastructure providers. This clearly reflects the different goals and objectives. Infrastructure managers are tasked with providing schools with square metres of physical learning space which alters with moving populations and changing demographics. Educators on the other hand aim to provide their students with a quality education. When surveyed about priorities, educators around Australia chose good acoustics as the overall top priority out of 40 variables. Top priorities include:

- Good acoustics
- Thermal comfort

- Air quality
- Ability to be reconfigured to engage different types of learners and activities
- Natural light and glare control
- Internal storage and display space

Below is a selection of comments by Victorian principals on prefabricated classrooms:

"As soon as you grow in size and get a lot of these portables, you can't use the new pedagogies in them and it has an impact on teaching, and the kids learning culture as well. It's a major issue for growth corridor schools."

"We've got 500 out of 1800 students in portables at our school and they're the worst spots in our school both visually and functionally."

"Heating and cooling costs are very expensive with portables because it's all electric."

"Having an outdoor space is really useful and having them (prefabricated classrooms) low to the ground would help us to create that outdoor space."

"It would be great to have the funds to create an outdoor space around them or to join them up to create a learning space between them – all those sorts of options make them really useable."

5] Verandas as outdoor learning spaces, Greenslopes Primary School, Qld

5



Conclusion

The drivers and priorities of infrastructure managers and educators diverge. Infrastructure managers' focus must be on the timely and cost effective provision of learning spaces whilst educators are concerned with the wellbeing of their students and the ability to deliver a quality education using recommended pedagogies. Ideally the aims and objectives of both groups would be reconciled through good design and quality construction.

Improving the design appearance of relocatables will hopefully result in designs that are positioned proudly within any school masterplan rather than hidden at the rear. What is arguably more important is that these buildings accommodate current thinking on teaching and learning. If we review prefabrication internationally we see tipping points occurring that will enable different approaches to mass customization. There is potential to efficiently design for different situations but to achieve this, the procurement of new relocatables needs to include a committed focus on design resolution as a conversation between infrastructure and education experts from departments along with designers and prefabrication manufacturers. The Future Proofing Schools competition has brought together many design possibilities which are a useful starting point for infrastructure departments, educators, designers and prefabrication manufacturers to have a conversation about what 'next practice' in prefabricated schools design might be.

“Temporary or not? This is possibly ‘the’ defining question when examining the provision of prefabricated classroom infrastructure in Australia...”

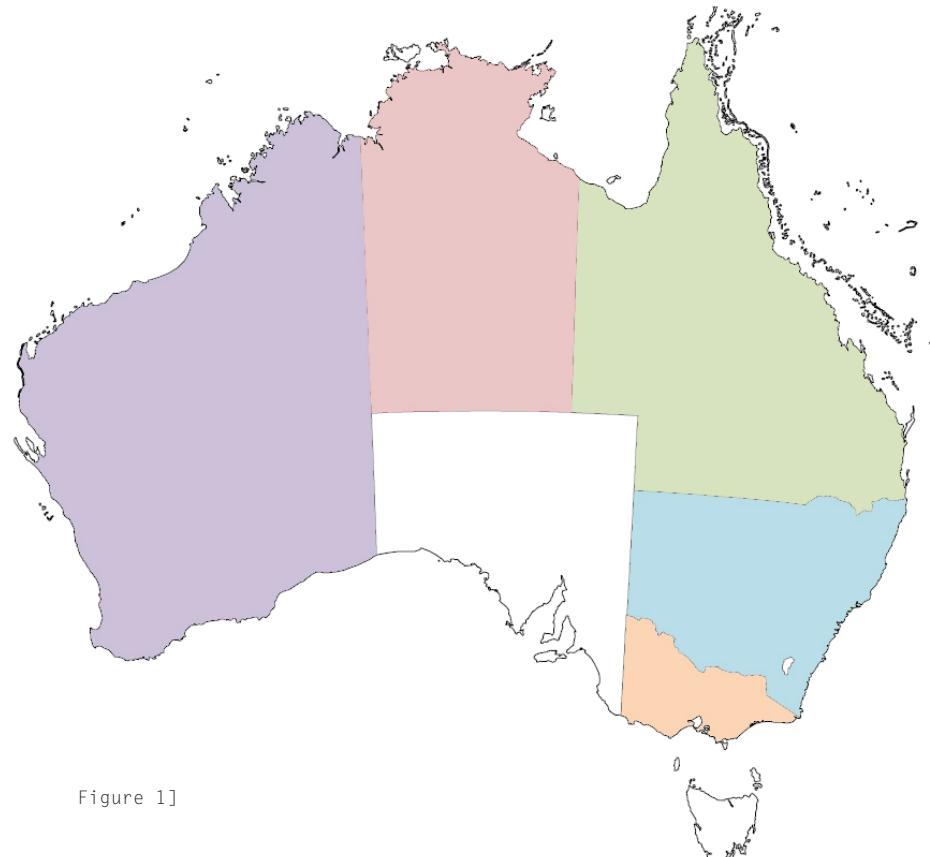


Figure 1]

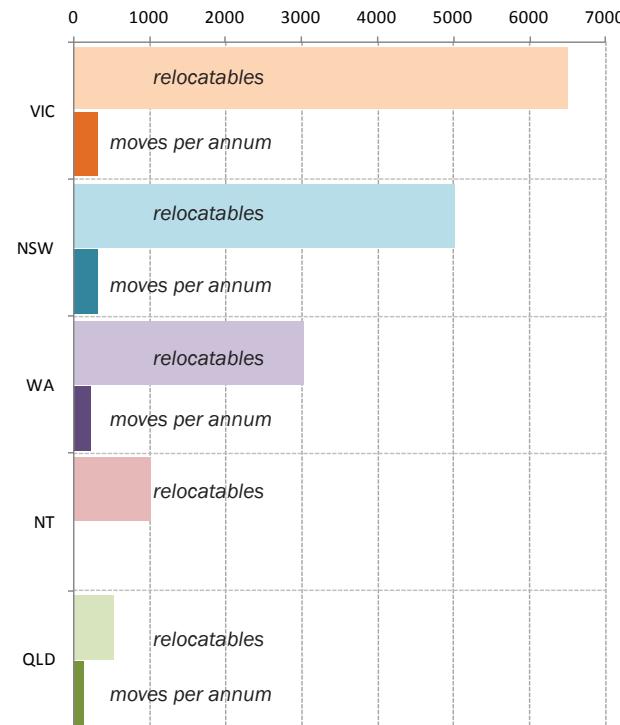


Figure 2]

Figures 1 and 2] Number of relocatables per State and number of moves per annum provided by Infrastructure Managers.
Please note that all numbers are approximate.

07

Temporary but Not!

by Lena Gan and Sarah Backhouse

“I don’t really see them as relocatables... we never seem to move them!”

Teacher, Metropolitan High School, Victoria



1] A relocatable classroom in metropolitan Melbourne

Temporary or not? This is possibly ‘the’ defining question when examining the provision of prefabricated classroom infrastructure in Australia.

The notion of temporary versus permanent impacts all facets of a prefabricated classroom provision starting with levels of user consultation through the procurement process to on-going maintenance. It becomes a core driver in determining: budget allocations; prefabrication systems; site placement, integration and landscape connections; visual appearance, design and quality; the refinement of the prefabricated classroom product over time; and a school’s sense of ownership of the buildings.

There are inevitably a number of ramifications around the fact that prefabricated classrooms are intended to be temporary, but in many cases are semi-permanent or permanent. Some of complexities around the issue are explored here.

The definition of temporary is relative

The notion of something being ‘temporary’ is perhaps one of the greatest problems in any discussion about prefabricated classrooms. The definition of temporary is also relative.

- These classrooms may spend five or six years at a school which from a student or parent perspective may be the entire time that the student spends at that school. Hence to students or parents, they are effectively permanent buildings
- Students attending a school during its demographic peak may be accommodated longer in prefabricated classrooms than in any permanent space.
- Despite being defined as temporary, the buildings themselves still have a 30-40 year lifetime and a purpose to serve in that timeframe.
- History has shown that many temporary buildings end up finding a permanent home at a school, so it is important that the design and quality are equivalent to those of a permanent building and that they are positioned carefully within the school environment in terms of access, orientation and outdoor spaces
- Perceptions of prefabricated classrooms as being both temporary and of lesser quality mean that they are treated differently. Many teachers said that students were easier to manage in permanent classrooms.

School communities are torn between wanting to better integrate these buildings into the school site and adapt them to teaching and learning needs, and yet not wanting to spend valuable funds on what is intended as a temporary space.

“We cannot deny the stigma that is attached to them. We need to work towards systems that mean that relocatables don’t look like relocatables, be that through form, materials or roof-lines – design in general.”

Are they really temporary?

The reality is that these buildings don't get moved around as much as might be expected for a variety of reasons:

- Schools don't like losing buildings as any available space is good space. Schools readily adapt spaces for after-school care and community and holiday programs for example.
- Moving, refurbishing and setting up these buildings is a costly exercise, so departments will only do so if necessary.
- In many remote communities there is a shortage of trade labour and materials. Prefabricated classrooms are therefore used as long term and often permanent solutions. Off-site construction is particularly cost effective in the NT where weather conditions, labour costs and availability, along with working conditions in remote areas make onsite construction unviable.

Allocation and removal

Schools provide enrolment data to Departments in the September to November period. This data is confirmed prior to the movement schedule for classrooms being locked down in early December. The majority of prefabricated classroom modules are moved in the period from December to February each year as it minimizes disruption to the school. At other times of the year, a school may receive a letter informing them that a building will be removed and giving them a single school term notice of that removal.

Maintenance

There is generally no specific funding allocated for the maintenance of prefabricated classrooms. It is the responsibility of the schools and because these classrooms may be removed from a school at short notice, schools will understandably use available funds to maintain permanent buildings rather than prefabricated ones. As a direct result of this, the general condition of prefabricated classrooms

deteriorates rapidly over time. One principal clearly stated that “*If we do work on them, we make sure that whatever we put in can be removed when they go.*”

Each time a building is moved, it is lightly refurbished in terms of data upgrades, minor repairs, re-painting and re-carpeting. Departments typically outsource transport and refurbishment of these buildings using a single contract.

Location and integration into the landscape

When existing schools reach a demographic peak and need new accommodation, there is often little choice as to how a prefabricated classroom is positioned due to site constraints. In the past the location of prefabricated classrooms was ad-hoc and they were often ‘*plonked in anywhere flat and convenient*’ or ‘*shoved down the back*’. With new schools however, such temporary classroom spaces are generally included in the Masterplan and an effort is made to integrate them into the school site.

The cost of installing prefabricated classrooms generally includes the connection to utilities and building stairs and covered walkways, to connect them to the main part of the school and other facilities. There is usually no landscaping budget to facilitate the visual integration of these buildings into the school site as, in theory, they are intended as short term solutions even though they are often in place for many years. In theory, they must also be easily picked up and moved. The new Bushfire Standards in a number of States are an additional deterrent to plantings, decks and the connection to external areas.

Another factor to consider is the Building Code of Australia's requirement for the floor level to be 500mm above ground. This space is required to provide access to the stumps, to connect utilities and for any maintenance work that might be needed. However, in most cases it makes it even more difficult to visually integrate these buildings.

Visual Appearance, design and quality

"We cannot deny the stigma that is attached to them. We need to work towards systems that mean that relocatables don't look like relocatables, be that through form, materials or roof-lines – design in general." [Infrastructure Manager]

Infrastructure managers interviewed unanimously agreed that visual appearance and design were high on the priority list of things to be improved and that in general there was an unnecessarily utilitarian approach to the design of prefabricated classrooms.

The lack of design has been largely attributed to

the procurement process which in most States deems these buildings as 'temporary' and therefore prioritises issues of capital cost, energy efficiency and construction for relocation. The departments provide specifications together with plans, sections and elevations with critical dimensions for the tender process. The successful manufacturers then build their own versions of the classrooms, so even with the same specifications, the quality and detailing of the classrooms will vary.

Within the portfolio of the same manufacturer it is possible for the prefabrication approach and detailing to vary significantly. One manufacturer was producing 'relocatable' classrooms for the Department, and at the same time manufacturing a different relocatable product for a hospitality sector client. The manufacturer mentioned that the other client group's architect had been involved in refining the design and detailing the buildings. This involvement was evident in the design and construction quality of the built outcome.

The dilemma

The range of issues discussed demonstrates the difficulties that infrastructure managers face when procuring prefabricated classrooms.

If these buildings are to be relocated after just a few years, then they should not be customised too much to suit the setting, clientele and climate of a particular school. Yet if these buildings are not customised in any way, the risk is that they will not provide the same quality of accommodation as a permanent building

and will never be integrated into their settings.

A consideration for the future may be the greater application of systems thinking, modularity, and interchangeability of components which will enable buildings to be rapidly and economically customised to suit a particular context, and then similarly adjusted to suit a new context. Entrants in the *Future Proofing Schools Design Ideas Competition* certainly explored a wide range of ways to provide delightful, tailored school environments that could be adapted to new settings. These approaches would require a collaborative effort from manufacturers and designers. As a large client group, the education sector has the capacity to be a major catalyst for such change through the amendment of their design and performance specifications.

In the meantime, prefabricated buildings need to be designed to ensure value for money, sustainability, quality detailing for longevity and learning spaces that suit 21st century pedagogies. One principal stated that "... if they're going to continue to be an integral part of the system, then they should be designed to suit the new pedagogies like the new permanent buildings." Before being manufactured in quantity, the design of these buildings should be optimised to avoid multiplying a product of questionable quality that is not well suited to end users.

08

Innovation Opportunities

by Clare Newton

1] Design and image by Husk Architecture | Interiors

1



There are tipping points occurring worldwide in prefabrication, sustainability technologies, 21st century pedagogies, and information technologies. To continue building new learning environments based on what was designed yesterday, without taking advantage of new possibilities, will be wasteful of scarce funding resources. While the complexity of predicting the future is a seemingly impossible task, emergent technologies and pedagogies are already visible on the horizon. We just need leading thinkers in the fields of education, design, infrastructure and prefabrication manufacturing to jointly develop a vision for, say, fifteen years time. From this conceptual future, it would then be possible to 'backcast' the necessary steps by government and industry in order to shift from gradual incremental improvement to system innovation.

The relocatable classroom is an important and useful infrastructure component; many students will have years of their education within relocatable spaces. Although prefabricated modules are currently used to provide additional generic space, they could play a more strategic role in helping the education system navigate change if designed to be more adaptable, more transportable, more appropriate and more delightful. The Future Proofing Schools competition visualises different futures using design scenarios. The designs are a starting point for conversations for education, infrastructure, sustainability and design experts to make innovative decisions about the future of prefabricated school buildings. It is timely to reflect on the need for change, the obstacles ahead and the associated risks.

Why innovate?

Relocatable classrooms are sometimes perceived as second-class learning environments that are less important than permanent buildings because they are only temporary. We have seen recent improvements to environmental performance but there are also opportunities to think more holistically about these spaces particularly as they accommodate so many Australian students.

Without good planning, a school with many prefabricated classrooms can look like a school in crisis; one that has had an unexpected and unplanned influx of students. Increasingly, relocatable classrooms are being positioned using sensitive master planning strategies to reduce the impact on playgrounds and link better with existing school buildings and other prefabricated modules. We see prefabricated modules linked together with decks and shading roofs and screens to encourage connections between spaces and to the exterior. Yet the classrooms themselves remain largely the same.

The benefits to seek when innovating prefabricated learning environments include:

- better integrated school environments
- better value for money with life-cycle cost savings
- improved teacher satisfaction with an improved workplace environment
- better student outcomes in terms of engagement, test results, reduced absenteeism, better health
- improved community amenity and built quality.

Changes on the horizon

The Future Proofing Schools brief outlined some of the tipping points on the horizon. Students are learning in new ways impacting on the role of teachers, space and facilities. New computer-aided design and manufacturing techniques are transforming the way buildings are procured. As the construction industry loses labour to other sectors, efficient factory construction will become more economically viable and provide higher quality construction that better meets environmental imperatives of lower consumption of materials and energy. The National Broadband Network will alleviate the tyranny of distance faced by remote communities. We hear about tele-medicine allowing doctors to diagnose and treat remote patients but we can also consider the benefits of tele-education allowing students and teachers from around Australia to collaborate.

What are the spatial implications of this innovation?
Distance learning becomes more streamlined with improved connections between students and teachers. Videoconferencing and immersion experiences will be possible. Professional development opportunities will not be tied to location. New learning opportunities will be available in games and simulations. Students will have easier access to information that will help inform their research tasks.

Changing current practices seems risky but not making decisions in the context of visible tipping points is also risky. We need to stop thinking that ‘temporary’ is a reason for lesser quality.

Innovation processes

Incremental versus Step Changes: Incremental changes are continuing to be made by education departments and prefabrication manufacturers to improve aspects such as energy performance and indoor comfort. But these changes are not yet resulting in relocatable buildings that schools proudly own as 21st century learning environments. It is time for step changes rather than incremental changes.

Top down and Bottom Up: There needs to be a demand for change. This may come from the community and users wanting better facilities and may also come from education, design and infrastructure experts. Authority to innovate needs to come from the top down as change involves taking calculated risks in a risk-averse environment. For innovation to flourish leaders need to have a degree of risk tolerance and entrepreneurial strength to support new ways of thinking about old problems. Innovation theorists describe the need for leaders to cultivate the skills of a gardener in order to ‘tend, prune and harvest’ new ideas within a clear vision for the ‘garden’.

Innovation Drivers between Sectors: Innovation in one sector will impact other sectors but this will occur more quickly if sectors collaborate. Australia is a large country with a conservative construction industry. The increasing shortage of construction labour is impacting the industry. We have an ongoing demand for prefabricated learning environments.

Concurrently we have a mining boom with a large

workforce living in remote communities who would benefit by improved prefabricated living environments, as would the teachers and health workers in remote communities. If the mining and education sectors jointly forecast their requirements for the coming decades, then investments in construction manufacturing will be more likely. Australia will finally have access to the quality of design and prefabricated construction that we see already occurring in Germany, Japan and Northern Europe.

Process, Product and Activities: The Future Proofing Schools competition focused on the product and activities. This alone is insufficient for innovation to occur. Process innovation is required for the many steps between design idea and built form. Infrastructure experts within Education Departments are not able to drive and deliver process transformations alone because the implications are broader than their discipline and, indeed broader than the many disciplines within education departments. Processes within the construction industries need to be included in any discussion.

The blocking points

The Difficulty of Multidisciplinary Thinking: In a society of disciplinary expertise, no one person has the knowledge to be effective across the diverse sectors of education, sustainability, design and construction. Within any large organisation such as our education departments, silos of expertise struggle to communicate across disciplines. The problems are not just the structure of these large organisations but are fundamentally to do with the way we each

perceive the world; our epistemological outlook. We use different terminology and different strategies to solve problems. We see different problems.

III-defined Contexts: A related core obstacle to innovation is the complexity of context in which decisions are made. The benefits of innovations, and the risks of not innovating are difficult to define. If we are to achieve step-change innovations, rather than the simpler incremental improvements, a process of expert solicitation is needed to ensure decisions are based on current knowledge. One strategy to consider when working with complicated scenarios is to look for acupuncture points where key changes may have powerful positive flow-on effects.

Dispersed Efforts: Changes in the prefabrication sector are occurring in Australia with design-led firms offering new prefabrication options and Japan's Sekisui House opening production in several Australia states yet these efforts are occurring largely independently. There appears little coordination of effort yet between providers. Prefabrication industry members could form an industry peak body to lobby government and the market regarding the benefits of prefabrication.

Entrenched Methods: There are entrenched relationships and ways of working within design and construction industries around the world. It is difficult for the architecture profession and the construction industry to work outside established methodologies and it may be for this reason that we see innovators in prefabrication in both Australia and internationally

coming from other industries such as industrial design and manufacturing rather than architecture and construction.

Regulatory Standards: Government regulations requiring higher performance particularly in the area of sustainability gives incentives to industry to invest in infrastructure which provides new products. While the initial costs of improved standards may be amortized across the life of a building, governments are required to make decisions in the context of three-year voting cycles. The impact of voters influences governments to avoid higher initial costs rather than consider life-cycle costs.

What was good enough for us is good enough for our children: The competition jury was surprised by the number of entries which displayed classrooms as rows of desks facing the front. We had described within the brief the range of factors which are changing the way students learn and yet some of the entrants still perceive best practice to be traditional classroom layouts. The conservatism was underlined by conversations with principals who are trying to shift teaching practice. They find parents, particularly in middle class suburbs want their children to experience the kind of education they themselves experienced.

Change in a culture of cost-cutting: Can change occur in an environment of funding cut-backs by governments? Cost is a crucial issue and yet planning for the future needs to occur in order to use limited funds effectively. Cost cutting is not a sufficient

argument for continuing with current practice particularly if new practices can lead to more effective use of limited funding. This is not to say that new designs will necessarily be cheaper but they may achieve more in terms of life-cycle cost savings and student, teacher and community satisfaction.

We can do better

Australasia is recognised internationally by the OECD as an innovator in educational spaces and during the last decade, primary, secondary and tertiary sectors have invested heavily in new spaces that recognise the importance of student engagement in learning. At tertiary level we see libraries transforming into collaborative environments and design attention being given to non-timetabled spaces for student-learning outside of lectures and tutorials. Within many new permanent buildings for Australian schools and buildings delivered as part of the Building the Education Revolution investment, we see a shift away from classrooms into more fluid environments of large and small, interconnected learning spaces. This level of innovation is not yet seen in relocatable learning spaces although there are some prefabricated permanent spaces in Australia that accommodate new ways of learning.

There is potential to transform the design of relocatable school buildings so they become exemplar spaces proudly located within the school context. They might be welcomed by schools as spaces in which to test and trial new teaching and learning strategies.

Conclusion

To explore future scenarios it is useful to bring diverse expertise together to develop a shared vision for change. Involving a broad pool of expertise from different disciplines will reduce the risks of innovation if issues are explored thoroughly. The voices of infrastructure, construction and manufacturing experts will be crucial for decisions to result in economical and practical outcomes. But the voices of forward thinking educators, designers and technology experts are also required as part of the conversation.

There are already changes occurring within the Australian prefabrication industry but deeper analysis of our future needs is required if we are to benefit by the step-changes which are on the horizon in prefabrication, pedagogies, technology and sustainability. The Future Proofing Schools competition is a useful starting point for conversations about the design of relocatable learning environments but the discussion needs to be much broader than just design and involve experts from many disciplines.

There are risks in changing but there are also risks in staying the same.



Design and image by Studioquint

Green Eggs and Spam

09 About Teaching in the 21st Century

by Lena Gan and Susan Wilks

10 The Net Generation

by Sarah Backhouse and Lena Gan

11 Challenges of Remote Community Schools

by Lena Gan

09

About teaching in the 21st century:

by Lena Gan and Susan Wilks

Most of us think that we know what a school is - after all, we have each spent around 15,000 hours of our childhoods at school. Perhaps we have children in school now, or are involved with schools in some other way as an educator, service provider or designer. This article provides a selection of anecdotes that attest to the widely or perhaps even 'wildly' diverse conditions and variables that prevail in schools around Australia. It reveals the complexity and variability of the situations, circumstances and issues that face school communities in the 21st century. We attempt to draw together critical reflexive moments from our research process, combined with observations and interviews from visits to schools around Australia and internationally undertaken during 2011 in preparation for the *Future Proofing Schools' Ideas Competition* on new relocatable learning environments.

During 2011, Future Proofing Schools researchers visited schools speaking with principals, educators and students in primary and secondary schools in five Australian states and territories. Schools visited were located in metropolitan, regional and remote areas and in a number of different climate zones. Catering for such a vast array of conditions and variables

requires multidisciplinary and inclusive approaches. Principals, designers, and infrastructure managers need to consider the specific needs of each site linked to the context and cultures of the end-users.

Key Themes

The key themes that emerged from the research are encapsulated here, linking stories told by educators around Australia in their day-to-day situation.

Discussion of the key themes includes anecdotal case studies from the research. These themes are:

1. Transport
2. Information Communication Technology
3. Literacy and English as second language or dialect
4. Acoustics and auditory processing
5. Visual connection between learning spaces
6. Indoor-outdoor connection
7. The timetable
8. Climatic conditions
9. Teacher and student transience
10. Special needs students

10 things you may not have thought about when designing a school

1



1] Challenging road conditions, Sandover Highway, NT

1. Transport

Although most of us just assume that students will turn up at school in the morning, this is far from the case at remote community schools in the Northern Territory where drivers daily cover an average of 600kms to collect and return students. The following anecdote provides a snapshot of how this transport can play out in the daily life of this school.

At a middle school in the Northern Territory located at the heart of a remote catchment area, a topic of conversation each day was transport and the condition of the roads. The unpredictability of daily life where the roads are often impassable and entire communities might go on walkabout means that classes, teachers, assistants, drivers, vehicles, lunches and locations require daily adjustment. This school must provide daily transport for its students, picking them up from the 14 communities within the catchment area. A fleet of five 'troopies' (4WD troop carrier) driving an average 600kms per day give students access to the middle school. The principal mentioned that despite the inconvenience and the enormous amount of time spent juggling transport, one benefit was they gained valuable insight into the home conditions of their students.

The transport situation in many remote areas has implications for the location of schools within a catchment area and the provision and cost of transport for students. It also has ramifications for the curriculum in terms of catering for the irregular attendance of some students due to the seasonal variability of road conditions.

2. Information Communication Technology

Technology is seen as a ‘must have’ by most schools. The effective use of ICT in a school curriculum is predicated on a strategy that incorporates an integrated system, adequate equipment, educators having the requisite training, and dedicated technical support.

In many schools we observed, islands of technology had been acquired in an ad hoc manner requiring the teachers - the key facilitators in the whole learning process - to somehow integrate it. It must become a seamless and ubiquitous part of the curriculum.

One Victorian primary school had an array of diverse products acquired at various points in time that teachers were struggling to integrate. At another school, half of teachers used the technology well whilst the other half, many older staff, lacked the training to use it, so avoided it. In contrast, staff at a secondary college in Melbourne ran a successful professional development weekend workshop around iPads for their peers as a fundraiser.

As ICT is indispensable for current students we must create learning environments that are as adaptable and fluid as today’s technologically sophisticated learners. Issues around ICT include providing sufficient computers, ensuring provision is not ad hoc, constantly updating technologies, teacher training, technical support, and a frequently reviewed strategic technology plan.

3. Literacy and English as a second language

Students (international and indigenous) for whom English is a second dialect or language (ESL) present unexpected challenges. Many schools have large cohorts of ESL students, both from other countries and indigenous students.

At one primary school located in a Sydney growth area, English is a second language for 96% of students. The students come from over 80 countries with the main groups being Indian, Sri Lankan and Chinese. They are so focused on learning and achieving good academic results that teachers have trouble engaging them in non-academic activities such as sport. Some of them do up to 14 hours a week of extra-curricular coaching which creates quite a different culture to that in most other public primary schools and brings up different issues. To balance the curriculum teachers created a focus on the performing arts and in particular dance to develop gross motor skills. This has been a huge success for the school community.

A principal who worked in Arnhem Land with indigenous communities for 15 years explained that indigenous students speak two or three languages before English but won’t necessarily admit to speaking any other than their main language. The English they speak is Aboriginal English which he explained was inadequate for the Federal government’s NAPLAN assessments based on western paradigms and the English language.

Cohorts for whom English is a second language

or dialect, or with specific literacy needs present particular challenges for teachers. Professional development in both ESL and ESL specific to indigenous students is available. One principal in remote WA has her staff developing an ESL/ESD curriculum that will be more relevant and tailored to the needs of the largely indigenous cohort.

2] Covered outdoor learning space, Wiluna, WA



4. Acoustics and hearing issues

Good acoustics are crucial for both students with auditory processing issues and teachers protecting their voices. Most Australian children will experience at least one middle ear infection causing temporary hearing loss while at school, with around a third experiencing middle ear infections intermittently. Some suffer from permanent hearing loss making certain sounds difficult to hear depending on the degree and type of hearing loss.

Excellent acoustics are particularly important for indigenous student as they suffer a higher percentage of auditory processing issues often due to chronic or intermittent middle ear infections. The prevalence of middle ear infections ranges from 40% to 70% in

indigenous communities according to the Australian Bureau of Statistics (ABS). Amplification systems in schools can enhance the acoustics. Interestingly, the ABS cites research that indicates access to swimming pools can help reduce ear infections as salt or chlorinated water has antibacterial properties.

At one Darwin primary school we were told by the principal that most indigenous students had middle ear issues and found English consonants very difficult to hear. The pitch of their own languages is much lower with many monotones. He said that schools often don't realize that students can't hear these sounds. When it's noisy, these students struggle to hear and will say 'tired, tired' from the effort of trying to hear and understand, then they will just tune out.

At a metropolitan high school, a large space the size of four classrooms and a corridor had been designed as an innovative learning space. However, it was performing so poorly acoustically that teachers would take their students to the library or computer room rather than stay in the space. At another metropolitan high school a large open plan learning space was designed with good acoustic treatments. When the Quantity Surveyor's cost plan was over budget, the acoustic treatments were removed and not replaced even when building tenders came in under budget. Parents attending a performance in the newly built space were shocked by how difficult it was to hear the performers.

Poor acoustic performance impacts on students, teachers and pedagogies. It can be tempting for designers or infrastructure managers to cut acoustic features from construction budgets as acoustic performance is an invisible factor, but this can result in unusable spaces at worst and unpopular spaces at best. An effective model was observed at a remote community school in Western Australia where many students had auditory issues. It installed amplification systems in all classrooms. Although an effective measure, it was expensive to get technicians from the city when there was a maintenance issue.



3] Covered deck areas, Wiluna, WA

5. Visual connection between learning spaces

Visual connection is one element in a learning environment that supports collaborative, multidisciplinary and project-based teaching and learning. This applies to both internal and external spaces and can affect the operational efficiency of a school.

Initially teachers at a Melbourne secondary school were apprehensive about all the glass in their new Year 9 Learning Hub, but soon realized some benefits. They felt less isolated and found it reduced discipline issues as students were less likely to misbehave when observed by more than one teacher. Seeing between classrooms also helped with using space and facilities more efficiently. A teacher could see that the class next door was not using its projector so she swapped rooms with this class to show her group a short film.

Principals of two remote schools were concerned by designs which required several teachers to supervise students during play. Both explained the need for outdoor spaces that connected visually so one teacher could see all spaces from one place - otherwise each space would need to be supervised. Different spaces such as quiet or active spaces also needed to be visually connected.

Although visual connection can initially be intimidating for educators and distracting for students there are some unexpected benefits. Visual connectivity creates a collegial atmosphere. Visually connected spaces encourage collaboration and cooperation and teachers and students learn from each other. They are also imperative outdoors where they impact

significantly on staff rosters.

6. Indoor-outdoor connection

A teacher at a secondary school lamented:

"There are very few spaces for the students to go when the weather is inclement. When it rains at lunchtime, they have to go into the corridors of the main building or the Library foyer. There is no covered outdoor space apart from the small atrium outside the canteen or the roof outside the gym, but it's a wind tunnel there. We desperately need a covered outdoor learning area".

A K-12 school in Sydney has a popular covered outdoor learning area attached to a classroom that

4] Large covered outdoor space, Wiluna, WA



comprises astro-turf flooring, glass on two sides to waist height and transparent plastic café roller blinds above that. Teachers attribute the popularity of this space to the fresh air, the quietness and the sense of being outside yet protected from the weather.

The availability of usable outdoor learning spaces was high on the wish list of many educators around Australia. Most Australian climate zones make outdoor learning spaces feasible for at least six months of the year, yet few schools have covered outdoor learning areas. Schools with good covered outdoor learning spaces appreciate that they provide the requisite additional space in a school, support new pedagogies and provide less structured alternatives to indoor spaces for most months of the year at a lower cost.

7. The Timetable

At a high school in metropolitan Melbourne staff explained that team teaching in the dedicated Year 9 Learning Hub was rare due to the multitude of issues around timetabling. Initially they had tried to retrofit the timetable to the spaces but this became a challenge because each term they were obliged to start this complex, often political and time-consuming process from scratch.

At one of the largest primary schools in a growth corridor outside Darwin, the Year 7s have recently moved over to the middle school resulting in flexibility around the scheduling of classes. Enough space has been freed up to allow team teaching for the first time in three years. Prior to this, there were eight classes

5] Display of student work in the classroom, Qld



in prefabricated classrooms and not a single spare space.

The timetable impacts the use of spaces in schools and can either facilitate or hinder team-teaching, interdisciplinary learning and learning based on 'big questions'. For team-teaching several classes need to be timetabled at the same time with access to collaborative learning spaces. This calls for juggling and flexibility of both time and space. Teachers also need time and space to plan for collaborative learning.

8. Climatic conditions

One of the features of each classroom at a large primary school in a Darwin growth corridor is a large

refrigerator. The high daytime temperatures necessitate the refrigeration of student lunches. At another school in Darwin lunches are collected each morning, put into a labelled milk crate, and then stored in the school's commercial cool room.

Although a number of schools in Western Australia have evaporative air conditioning this does not function in conditions of high humidity, so teachers open the windows to combat stuffiness. However, without fly screens the classrooms quickly fill with a myriad of insects. Lack of adequate shading in some Western Australian schools means that direct sunlight comes into classrooms, sometimes burning students at their desks. Many teachers resort to covering windows with student work or paint them to cut the heat and glare of the sun. The disadvantage of doing this is the resultant lack of natural light and visual connection with the exterior; both important for student and teacher wellbeing.

The different climate zones each have their own idiosyncrasies which impact schools, such as high temperatures and relative humidity, strong sunlight and cyclones. Each require infrastructure and design strategies to mitigate their effects.

9. Teacher and student transience

At schools around Australia we found different types of transient populations.

A primary school in outer Perth has a unique group of high-risk students from Defense Force families. The students can '*just disappear overnight*' due to

parental re-postings. This makes it hard for the school to know how best to cater for their needs.

The catchment area of a remote Northern Territory middle school fluctuates between 800 - 1,200 people (14 communities). There is also a lot of movement in and out of the school. The more traditional an indigenous community is, the more responsibilities teenagers have for their families. Child and aged care are two reasons that may cause these students to be out of school for months at a time.

At remote community schools visited in Western Australia and Northern Territory both teacher and student turnover are high. It is difficult to find teachers who are willing to work in a remote location and deal with the community housing, limited and expensive food, health, substance abuse as well as students' home life issues while maintaining focus on teaching and learning. It takes compassion and perseverance to work in these situations. Teachers wear out with the complexity and relentlessness of the issues.

A further complicating factor for remote schools is that students may have high absenteeism. At one remote school the attendance list was an important event graphed and discussed with students each morning during an informal outdoor assembly.

Many schools must deal with transient student and teacher cohorts associated with their particular circumstances such as the mining industry, defense force postings, isolation or other hardships. In some remote areas, incentives are offered to attract

teachers and encourage them to stay. This has had mixed success and particularly impacts indigenous cohorts for whom stability is vital.

10. Special Needs Students

Most of the schools visited on research trips had varying cohorts of special needs students. Special needs categories included learning difficulties, auditory processing problems and behavioural issues such as autism.

A Darwin primary school has 25 students with identified special needs who qualify for extra support in the classroom. It also has another 25 who are just below the threshold. The placement of all these students is important and teachers must ensure they are not put into noisy classrooms for example.

Teachers at a New South Wales regional primary school are proud of their students for the way they accept and care for their large cohort of special needs students. These students are not picked on or bullied but instead are willingly helped by their peers and are fully integrated into normal classes via a buddy system. The teachers expressed their concern about what might happen when these students transition to the high school with a much larger catchment area and a lower level of acceptance.

There are mixed feelings about the classification of special needs students. Those just below the threshold often miss out on additional support due to lack of funding. Some schools have allocated funding from other areas to support these students

but others, although aware of the issues, do not have the financial flexibility to be able to do this. Some special needs students are particularly sensitive to noise and this underpins the need for good acoustic performance. Another factor that requires attention is the transition points for these cohorts within the education system.

In conclusion:

The ten things you may not have thought about when designing a school are recurrent themes raised by principals, teachers and students in the schools visited during 2011 across six education departments around Australia. We have included the narratives given by the research informants as experts within their schools environments.

6] The school garden as an outdoor learning space, Qld

HANDS ON

SCHOOL GARDEN

10

The Net Generation

by Sarah Backhouse and Lena Gan

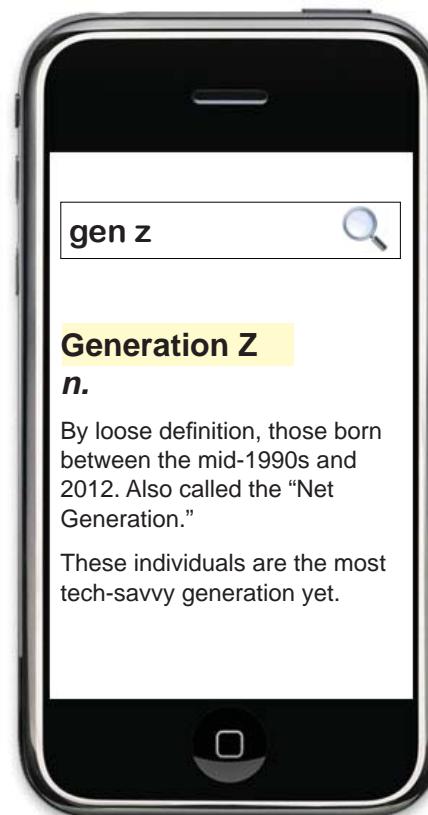
Today's world is grappling with a number of coexisting generations who experience and live with technology in quite different ways; these differences are normal in the face of such rapid technological and resulting cultural change. When it comes to understanding generational differences, Douglas Adams' insightful observations in *The Hitchhiker's Guide to the Galaxy* still hold true:

- *Anything that is in the world when you're born is normal and ordinary and is just a natural part of the way the world works.*
- *Anything that's invented between when you're fifteen and thirty-five is new and exciting and revolutionary and you can probably get a career in it.*
- *Anything invented after you're thirty-five is against the natural order of things.*

This 'natural order of things' tends to be amplified in the context of our schools where the spaces and technology are generally designed or defined by those from Gen X through to Traditionalists.

A full review of the emerging technologies, the trends, and the implications on the design of learning spaces are outside the scope of this short compilation, however the following collection of quotes and observations highlight a selection of issues and opportunities that have emerged during the course of our research.

"Today's schools are educating kids for the past not the future"
Ian Yorston, CEFPI conference 2010



10-YEAR-OLD HACKER FINDS ZERO-DAY FLAW IN GAMES

by Seth Rosenblatt, August 7, 2011 C|Net

A young hacker known as CyFi details an entirely new class of vulnerability in mobile device games...

The girl from California first discovered the flaw around January 2011 because she "started to get bored" with the pace of farm-style games. CyFi said, "It was hard to make progress in the game, because it took so long for things to grow. So I thought, 'Why don't I just change the time?'" Most of the games she discovered the exploit in have time-dependent factors. For example, planting corn might take 10 real-time hours to mature in the game. Manually advancing the phone or tablet's clock forced the game further ahead than it really was, opening up the exploit.

http://download.cnet.com/8301-2007_4-20089152-12/10-year-old-hacker-finds-zero-day-flaw-in-games/

"We move between Gardner's theory of multiple intelligences back to Dewey's theory of experiential learning, and find you can actually join the dots between those two theories with technology. If students retain more through an interactive and kinaesthetic approach, then every surface in a learning environment could and should be delivering some form of information rather than just being isolated technology objects in a space."

Andrew Beveridge, Managing Director of Teamboard

"Technology is changing so rapidly. When the school opened in 1997 we had the most advanced technology in the State... but now we're constantly retrofitting...If the building was made out of panels then we could simply pull them out and upgrade them! It should be a like a giant Meccano set."

IT Manager, Primary School, WA

"We tend to use online resources... if we purchased programs they would simply be obsolete in 6 months."

Principal, Primary School, NT

"There's a great divide – a lot of older teachers only use the technology they're comfortable with. They don't know how to use the technology and don't feel that they have time to learn."

Teacher, High School, VIC

10 considerations for educators and designers today

1. Islands of technology such as computer rooms and banks of PC's are outdated.
2. Technology must be seamless and *integrated*, not an add-on.
3. All learning environments should be *planning appropriate infrastructure* to support new technologies.
4. Technology is a gateway, yet the key facilitator remains the teacher(s).
5. Training and ongoing support of teachers in technology use is vital.
6. Educational software provides 'toolsets' that mean both students and teachers can compile information and create presentations very quickly.
7. Every surface in the future learning environment should have the potential to deliver some form of information, both inside and outside.
8. The capacity to learn, share, and collaborate locally, nationally, internationally and 'live' through new technologies is incredible.
9. New technologies will impact curricula, timetables, measurements and assessments - and will also impact the spaces that house these activities.
10. Technology is second nature to today's children; let's not hold them back.

"The school is very aware of learning in the digital age. Our consultants and full time IT manager are helping us in the transition to The Cloud, to Moodle and to other technologies..."

Principal, K-12 Catholic College, NSW



St Joseph's Primary School, Mernda, Victoria

5 technology generations in 2012

Traditionalists	67 + yrs
Boomers	48 - 66 yrs
Generation x	35 - 47 yrs
Millennials	18 - 34 yrs
Gen z or NetGen	0 - 17 yrs

"Gen Z prefers communicating through social networks and instant messaging, and considers email 'so yesterday'..."

Grail Research

"I think there's a lot of technology in here that is not used or is old – computers take ages to boot up – they're really slow and they shut down a lot. We're at the mercy of the old school computers..."

Year 9 Student, High School, VIC

11

Challenges of Remote Community Schools

by Lena Gan



Introduction

The *Future Proofing Schools* research project included visiting and spending time at remote community schools in the Northern Territory and Western Australia. This report provides a snapshot of observations from these two community schools along with the views of educators with extensive experience in remote communities. One of the schools was located in a highly decentralized community with a strong commitment to traditional practices and customs. The other was located in a remote township adjacent to a number of mining activities.

Some of the operational factors that are part of everyday life in a remote community include: fires, floods, road conditions, the cost and availability of vegetables, venomous snakes, diseases carried by mosquitoes and flies, lack of mobile phone reception, late mail planes, dust, irregular supplies, absent students, issues with telecommunications, isolation, climatic extremes and transport. In terms of the students' wellbeing - nutrition, hygiene, cleanliness, living conditions and attendance are ever-present concerns. The ways some of these play out in school life are discussed below.

1] Lunch at Wiluna, WA

Arlparra

After a long drive from Alice Springs on roads that varied from endless corrugations, deep sandy stretches and hard rocky ground to rivers of water, we finally arrived at the school in the heart of Utopia Region. On arrival at Arlparra Middle School we found that the principal and school administrator had gone to assist a bogged Telstra technician located over an hour's drive away. Road conditions, disabled vehicles and transport rosters were the dominant topic of conversation during our stay at the school.

The principal explained that there are two very diverse approaches to remote education. One is to incorporate the indigenous language and culture into the education as much as possible. This is difficult in a highly decentralized community of small groups with different languages. The other approach, the one adopted at Arlparra, is to make school a safe, stable and supportive place for students. This includes assisting them to learn how to interface with the Western world, about how it functions, and its values and cultural expectations. According to the principal this allows them to determine the terms of their integration, and for children living in 'country',

school may be the main slice of Western life they get. It's important to understand that these students must straddle two worlds and cultures, one that is over 60,000 years old and the other that is merely centuries old. For some remote communities, Western education has only formally been available for the past decade, so it's a whole new world for many students.

Arlparra Middle School is located in the Utopia region approximately 270 kms northeast of Alice Springs. The region measures 3,500 square kilometres, has a population of around 1,000 people and is on the eastern perimeter of the Western Desert. It is estimated that indigenous people have occupied this region for over 40,000 years. The main languages are Anmatyerre and Alyawarre. This minority community has mostly declined to live in the western style and continues to live in traditional clan sites and adhere to traditional practices. According to health surveys the reliance on traditional bush foods, a more active outstation lifestyle and the fact that alcohol is not permitted in Utopia, seem to have resulted in comparatively better health than in similar communities.

The principal at Arlparra believes that the Arlparra school setting underpins her authority:

The community sees me as both the principal with authority and an advocate for their children. And it's important for the students to feel important and for the community to see that their children matter and that they are going to get the best.

It is a point of pride for the Arlparra community that their school is like a school anywhere else.

Living a traditional life

There are a number of ramifications associated with living a traditional life. The more traditional the community, the more responsibilities teenagers have for child care, aged care, caring for country and other cultural commitments that all require spending time away from school. Boys often leave school at 10-13 years of age when they undergo the first stage of initiation. They may come back at around 16 years of age or may not.

The principal at Arlparra explained: "*We must negotiate everything in this community, but it is often unclear with whom*". She said that the community-owned store was the social centre where negotiation happens if you can manage to be there at the right time. Another principal who had worked in remote Arnhem Land for 15 years explained there were really complex protocols around conversations and negotiations.

Kinship groups and avoidance is another issue, for example 'poison cousins' can never be in a room together and there are strict lines drawn around who can converse, and names that cannot be spoken. To mitigate these issues, the Arlparra principal split the middle years' classes into male and female. for example, different cultures may have different behavioural protocols; directness, direct eye contact and asking questions may be considered impolite within some indigenous cultures. Indigenous people

learn by watching or observing then trying things out. Explicit teaching is done via songs, ceremonies and myths, and information or knowledge is given when it is required.

Wiluna

A Department of Education manager described Wiluna as “challenging”. The township of around 300 is not in a ‘dry’ area and there are issues such as substance abuse and violence within the community. The largely settled indigenous population derives from different tribal groups, a fact that has contributed to problems in the past. The school we visited was only a few years old and had replaced a school that was inappropriately located across the road from the pub and in poor condition. Since the new school opened, vandalism had ceased within school grounds.

Wiluna is located in a mining region and the modern practice of ‘fly in, fly out’ means that the community has seen few new residents. The Australian Government and the Minerals Council of Australia set up a Regional Partnership Committee in 2005 with the aim of improving the socio-economic wellbeing of indigenous Australians. The school principal had sourced funding for many projects through this Committee.

Wiluna’s principal believed that it was important for a school to look beautiful, organized, clean, bright and ready for learning.

This is fundamental particularly in remote communities where students might come from sub-standard living conditions. This environment

indicates to parents and students that it is a serious place for learning.

Learning styles and language

In Arnhem Land, doors are open all the time and much of the learning takes place outside. We were told that it was important to keep indigenous students physically mobile. A Darwin principal explained that indigenous students’ idea of play is a lot more physical than that of Western students: *“They’re much more tactile than us and are more attuned to their bodies and the environment than we are. They like to jump, tumble and fight on the mats and call it ‘bumping’. They are obliged to try and balance the Western world and the one back home in remote communities.”*

2] Primary school students at Wiluna, WA



The very hands on, kinesthetic learning style of many indigenous students lends itself to artistic, musical and multi-media projects where they can work things out for themselves. “They learn by watching and doing. They don’t like people talking at them.” A teacher in the NT explained that when teaching a group of students a particular drum beat, they would each have a turn until one of them worked it out then he would teach all the others. “It happens really quickly – it’s almost viral.”

In Australia, Aboriginal English is a recognised language and is what is called ‘functional English’. All Aboriginal students at both these schools have English as a Second Language (ESL) or dialect (ESD). Many of them speak a number of languages. The

3] Covered outdoor space, Wiluna, WA



principal at Wiluna, whose staff is working on an ESL/ESD curriculum, explained that “*Teachers teach in standard Australian English, but if you only did that in this setting, there are really important language steps that students will miss out on.*” All educators interviewed remarked that the NAPLAN assessment was not appropriate for many indigenous students as it is based on western paradigms and Australian English.

On being a principal

As the principal at Wiluna pointed out, teaching is one small component of the job of a principal in a remote community school. She described all the comings and goings, as well as the training and testing requirements, admitting with regard to professional

development around interactive whiteboards: “*It’s incredibly difficult to schedule it all in and occurs whenever it becomes a priority which is crazy as interactive whiteboards are a powerful teaching tool.*”

Another principal explained that taking indigenous students to medical, dental and hospital appointments was just “*something you do as part of the love of the job. ... You’re virtually the business manager as well, managing and allocating funds, then there’s staff, parents, students, curriculum and pedagogy.*” His school keeps a box of shoes for students who turn up without them and provides meals at the after-hours homework centre.

Conclusion

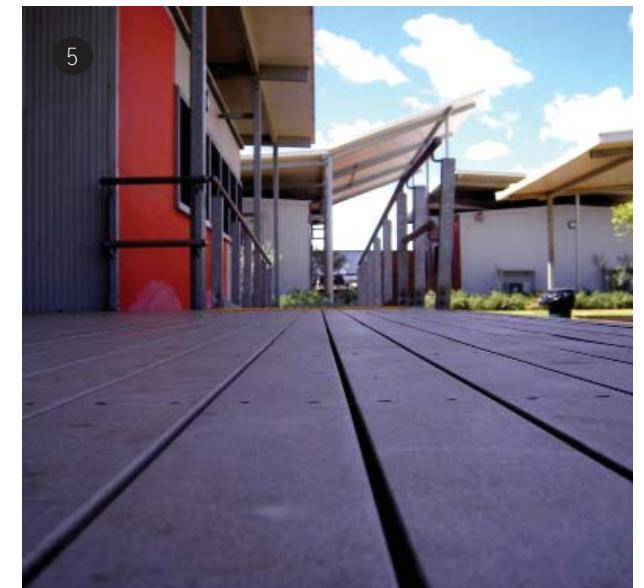
Teaching in remote communities is challenging for most people. The NT Remote Teaching Service website sums it up nicely.

“Teaching in a very remote Indigenous school is a commitment. It is not for everyone. It is hard work and the conditions can be tough. You may find it personally and professionally demanding yet it can be immensely rewarding too. Every day can bring a fresh challenge, calling for a wide range of skills. To succeed you will need to be innovative, resilient, a good communicator and passionate about teaching.”

4] A Homeland school, Utopia region, NT



5] A Remote Community School, WA





Design and image by Tridente Architects

Galvanising the Industry

12 Prefabrication: An ‘old’ new idea

by Clare Newton and Sarah Backhouse

13 Australian Prefabrication: Galvanising the Industry

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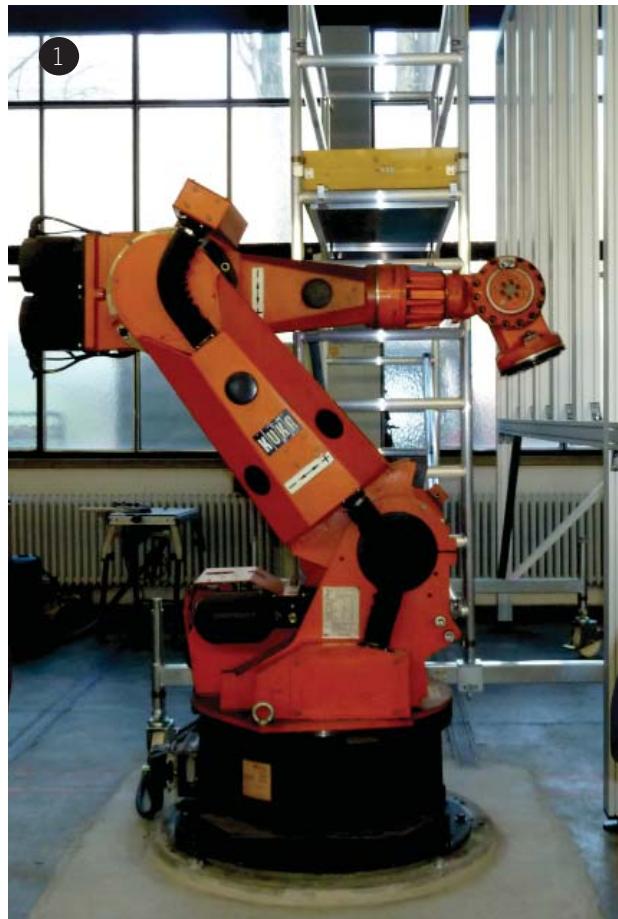
by Tom Kvan

12

Prefabrication: an old new idea

by Clare Newton and Sarah Backhouse

1] Construction robot at the Technical University of Munich, Germany



Prefabrication has excited designers for decades as a way to provide more affordable, mass-produced buildings but transformation of the construction industry has proved elusive. One premise for the *Future Proofing Schools*' research was a belief that Australia is finally at a tipping point that will result in a major shift towards prefabrication. To test our assumption, we travelled to manufacturers in Australia, Germany, the UK, the Netherlands, the USA and Japan. As well as visits to factories and interviews with a number of manufacturers both nationally and internationally, we interviewed academic experts in the field including Professor Alistair Gibb of Loughborough University, Professor Thomas Bock of TU Munchen, and Professor Shuichi Matsumura at the University of Tokyo who have all provided us with their frank evaluations. This article contrasts the various levels of technology and automation we witnessed. We remain hopeful, but not as confident, that the transformation of the Australian construction industry is inevitable.

An industry resistant to change

The construction industry resists change. Widespread investment in new technologies will only occur if

driven concurrently by entrepreneurs within industry, a strong economy, market demand, government and the design professions.

This alignment between sectors would be timely for Australia if not inevitable. The Australian construction industry is suffering a worsening shortage of labour alongside a resources boom. Computer-aided design and manufacturing technologies, mass customisation options and sustainability imperatives indicate that prefabrication is likely to become more competitive. Certainly prefabrication options are already increasing for the Australian housing market with small design-led firms opening factories along with one of Japan's largest prefabrication manufacturers, and companies such as Unitised Building launching an efficient prefabricated system for high-rise apartments. Whether these are indications of an imminent boom in prefabrication or a smaller adjustment for boutique markets will become known in the next decade or two.

Digital technologies

Developments in computer-aided design and manufacture have transformed other manufacturing sectors; the aerospace and automotive industries

embraced these new technologies decades ago while much of the global construction industry relies on in situ assembly including that in Australia. With the increasing proliferation of digital technologies into design and production systems, the future of manufacturing presents us with endless possibilities. Late 2011 in China, a thirty-storey hotel was assembled in just fifteen days¹. Such speed in assembly requires developments such as Building Information Modelling (BIM) enabling accurate alignment of structural, componentry and service systems.

Although much of the global construction industry has been slow to translate technology-led manufacturing principles to construction processes, there are notable precedents in Japanese, German and Northern European markets.

Japan, Germany and the Netherlands

Germany, the Netherlands and Japan were the most developed prefabrication markets we visited and were remarkable for their degree of automation. Quality of product underpinned these more mature markets. Architects in the Netherlands spoke about permanent quality, temporary buildings. In Germany and Japan prefabrication is perceived as higher quality and more desirable than in situ construction. German prefabricators such as Huf Haus and Baufritz emphasise sustainability initiatives.

Japan's strength in manufacturing ensures

1. <http://newsfeed.time.com/2012/01/10/chinese-builders-construct-30-story-hotel-in-15-days/>

The Netherlands

One manufacturer we visited has two factories linked by a small railway line, so steel framing is completed in one factory then conveyed to the module fabrication factory. Module fabrication is carried out on an automated construction line driven by CNC machinery. Entire elements such as wall panels are framed using machine cut components that are then machine nailed. At each step, panels are automatically tilted to expose the correct face in readiness for bracing, insulation and cladding. Zones for elements such as services and/or windows are predetermined and machined during this process. These panels are then incorporated into the structural steel frame of the module.

This automated fabrication process is prefaced by a high degree of design refinement, and prototyping is a critical first step. The project on the production line at the time of our visit was a student housing project that involved a total of 2,500 studio apartments. A number of iterations of the prototype had previously been fabricated and reviewed by factory technicians, the project architect and the client in order to find the optimum outcome in terms of quality, cost and speed. The final prototype was fully 'dressed' which allowed all parties to review fabrication and installation issues, as well as colour schemes and furniture arrangements. This also allowed the client to take photographs for marketing purposes prior to the units even being installed on site.

meticulous detailing which withstands earthquakes in contrast to Australia and the USA where prefabrication is still more commonly associated with retirement villages, low cost housing and temporary school buildings.

Since 1976 Toyota has been applying CAD/CAM, and more recently robotic, technologies to their housing division. Other Japanese prefabricated housing manufacturers such as Sekisui House, Misawa Home, Daiwa House and Sekisui Heim adopt similar integrated processes with a mix of robotics and traditional construction.

Notably, with the exception of Misawa, these Japanese firms did not evolve from traditional craft based construction firms; they were started and invested in by large conglomerates such as steel fabricators and material companies who leveraged their R&D and market research in search of a showcase for their products².

The UK and the USA

Factories visited in both countries relied more on 'indoor construction' rather than automated manufacturing processes. One UK factory we visited had invested heavily in process automation but had to sell equipment and revert to more standard construction when an anticipated hotel project fell through. The prefabrication business model normally

2. Gann, D 1996 *Construction as a Manufacturing Process: Similarities and differences between industrialised housing and car production in Japan*, Construction Management + Economics 14, p437 – 450

requires high turnover but a US firm, Project Frog uses another strategy to deal with fluctuating demands using a kit of parts approach which can be built by any manufacturer in any location.

Australia

Visits to a number of Australian manufacturers have shown a more low-tech approach; more ‘indoor construction’ than ‘manufacture’. An interview with one local, design-led housing manufacturer suggests they are at a tipping point currently producing nearly a hundred houses each year using a low-tech production line. “*Do we make the significant*

investment in automated technologies and the larger factory setting that would require? Do we remain with our more labour intensive model which a certain number of clients are prepared to pay for?” Another local manufacturer whose core product is medium to high density prefabricated apartment modules has recently made the transition to a more automated production line to undertake higher volumes.

Conclusion

Pressure to change and adopt new technologies may come from abroad as well as locally. Sekisui House established Australian factories in late

2009 and is working towards an annual turnover of circa AUD \$1.2 billion by 2015³. Although their primary focus is on the housing market, they are also interested in exploring other sectors such as education. Alternatively firms investing in automation within Australia may struggle if volume drops away as happened for a UK firm we visited or more recently, a manufacturer we visited in the Netherlands. The Australian prefabrication industry has potential to thrive but only with nurturing, planning, collaboration and a little luck.

3. <http://news.smh.com.au/breaking-news-business/sekisui-to-build-brand-trust-in-australia-20101107-17imx.html>

Japan

Three distinct prefabrication production methods were viewed in Japan beginning with a visit to the world’s largest factory producing unit housing (rather than a kit of parts or flat pack approach). Sekisui Heim uses a mix of robotic and hand construction with 80% of each house completed in the factory. Houses tend to be small with an average house using 13 modules or units. Each unit takes approximately five hours to complete in the factory and 130 units (or ten houses) are completed daily. Units are 2.5 or 1.3 metres wide and range from 1.8 to 5.4 metres in length. Ceilings and floor linings are placed with automatic feeding machines and screwed with robotics. Packs of colour-coded wiring are laid into a reversed ceiling at waist height which is then inverted for final fixing. A large unit assembling machine puts together the floor, ceiling and walls with robotic welding of all eight corner joints at once. Accuracy is checked by another robot making 9,000 checks in two minutes. After assembly of the frame, external wall linings are placed and fixed with concealed daisy rivets. Units are finished in two factory lines with a fast track line for the more straightforward units and a slower track for units with stairs and bathroom or kitchen fittings. A customer’s order can take just one month in the factory, a day to be assembled on-site and a further month to finish.

At Sekisui House, the prefabrication approaches are distinctly different. As well as the steel factory, timber factory and recycling factory, there is a House Museum and display village on-site. The steel construction factory includes highly automated processes for cutting, drilling, welding, assembling, coating and baking. The second factory for post and beam timber construction systems uses concealed steel brackets ready for on-site joining. In the timber factory, 3D computer models track each component being manufactured. The third factory visited at Sekisui House is entirely for recycling waste products and development of waste into new products such as recycled plastic roofing battens. Virtually all waste is recycled with figures for September showing 0.02% discarded. The recycling factory is located adjacent to the ‘Zero Emission House’ which includes a moss covered roof, photovoltaic cells in glass, recycled glass floor tiles, photo catalyst wall coatings and smart systems for energy monitoring.

Sekisui House is one of the world’s largest housing manufacturers having built 2 million houses since the 1960s. About 30-40% are still standing. With 57 million housing units across Japan currently, Sekisui House has built around 1% of current housing stock.



"Zero Emission House" at Sekisui House's Zero Emission Center in Koga City, Ibaraki Prefecture

13

Australian Prefabrication: Galvanising the Industry

by Sarah Backhouse

In mid-2011, one of our research events involved taking 50 delegates to the factory of a design-led modular housing manufacturer in Melbourne. This diverse group included architects, architecture students, educators, facilities managers, as well as the bus driver who preferred to join the tour rather than linger outside with the bus. If any delegates had harboured negative preconceptions of prefabricated housing prior to the visit then they all left as converts, including the bus driver who clutched the sales brochure tightly in his hand. On the trip back, he excitedly told us that he might have found the solution for his rural block of land as the high quality modular homes had the potential to operate ‘off-grid’ with minimal add-ons, the houses were fast to install, looked great and the price per square metre was reasonable too.

Such anecdotes suggest that the new generation of Australian prefabricated housing manufacturer has dealt with one of the major impediments to the industry in years gone by; the negative stigma that stems from prefabrication’s association with utilitarian, mediocre quality, low cost buildings that are often retained well beyond their intended life. Over the past decade, there has been a resurgence of interest in prefabrication both nationally and internationally, an interest that is shared by local leaders in construction innovation. For example, the report¹ *Construction 2020* outlined eight visions for how the industry can provide better quality and efficiency, and highlighted the vital future role for off-site manufacturing of buildings and their components.

“My vision for 2020 is one where construction methods will minimise on-site labour – more prefabrication. Buildings may be more transportable, moving or growing as required. Sustainability and re-use of building materials will drive materials and construction methods.”

1. Hampson, K & Brandon, P, 2004 *Construction 2020: A vision for Australia’s property and construction industry*, Cooperative Research Centre for Construction Innovation

They also observed a number of barriers to this vision, including the natural conservatism in the Australian market influenced by limited past success; lack of investment required in plant and equipment; lack of flexible open systems with designed-in flexibility; and the Australian preference for individualised solutions. Our research confirms other findings² that little co-ordinated effort has been made within the Australian construction industry to bring about an increased uptake in prefabrication.

From our research interviews, we have noted an important factor that differentiates our local industry; Australia does not have an industry body dedicated to representing and galvanising our prefabricated building manufacturers. In the UK, Japan, the United States, across Europe and in New Zealand, such industry bodies work to advance research and development, educate the public, share knowledge, promote their products and also lobby institutions such as government departments, financial institutions and other sectors of the construction industry.

We have identified the following core areas where an Australian industry body could have a coordinated and positive effect on the understanding and uptake of prefabrication in the construction sector.

1. Terminology

The interest in prefabrication goes through cycles

2. Blismas, Nick et al, 2007, *Off-site manufacture in Australia: Current state and future directions*, Cooperative Research Centre for Construction Innovation

of popularity throughout history, and at times it has been synonymous with mediocrity or poor quality, leading to a certain stigma which lingers today. This suggests one reason for the emergence of so many alternative terms as proponents of prefabricated systems are seeking to distance themselves from what has been described as “*a long continuum of noble failures*”³. However this wide number of terms leads to confusion, something that our research team can attest to.

Industry bodies in other countries are seeking to clarify the various terms and their definitions, thereby educating the public while at the same time promoting their products.

1] Het 4 Gymnasium School, Amsterdam by HVDN Architecten and URSEM BV



3. Arief, A., Burkhart 2002, *Prefab*, Gibbs Smith, Utah

2. Perceptions of quality and relocation

A prefabricated building’s ‘potential’ for relocation is no guide to its quality. International precedents such as the Het 4 Gymnasium School in Amsterdam show that a ‘relocatable school’ can be designed and constructed to a permanent quality, and an increasing number of local modular manufacturers are offering high-quality ‘relocatable’ building solutions.

Prefabricated modular buildings are generally manufactured in a controlled factory environment, offering the scope for improved quality control and the ability to work to finer tolerances in both fabrication and assembly. Ultimately, the buildings and their components need to arrive on site in ‘factory condition’ so they are designed and built to withstand the many stresses of transportation and installation.

As with traditional on-site building methods, the level of quality is a function of the budget, the design, the details, the building’s specifications and its construction.

3. Common understanding

Many architects believe they can approach prefabricated building manufacturers in the same way they would approach a general builder, to seek a tender price on their bespoke design. During our research, manufacturers in both Australia and abroad described a common scenario of architects approaching them with finished designs and asking for a price for the ‘modularisation’ of this bespoke idea, then being surprised by a less than competitive price which covered the manufacturer’s

'inconvenience' for creating a 'one-off'.

Understanding the design parameters of a manufacturer's system - for example knowledge of component or module sizes, designing layouts to an appropriate planning grid, not placing windows on grid lines, and so on – will facilitate the manufacturer's production of a customised project.

"Designing for off-site construction does not stop you building a project traditionally, but not designing in advance for off-site construction significantly limits your options." Modular building manufacturer, UK

"Of course we have standard products but 99% of what we do is customised. We work with our clients or their architects to create tailor made solutions from our highly refined system." Modular building manufacturer, Victoria

4. Volume as a driver

Prefabricated building providers are in the business of *manufacture rather than building*. Their business model requires a defined level of volume to cover the overheads of a factory setting, equipment and an incumbent labour force. These overheads remain constant, so a constant work flow is important. Only with a more certain volume of production will manufacturers be able to commit to the significant investment in more automated, computer driven manufacturing equipment and associated staff training.

This suggests that a diverse portfolio is required

by a manufacturer to achieve such a certainty of volume. The housing market plays a vital role in creating demand for prefabrication innovation, as do other building typologies that generate volume from different client groups, for example the education and healthcare sectors.

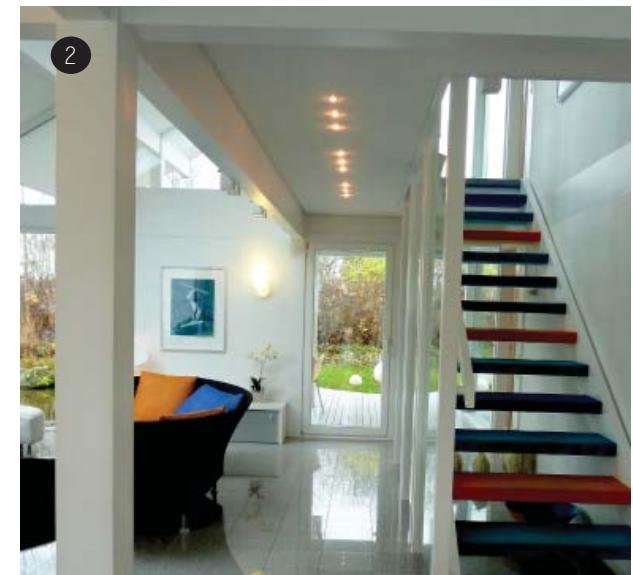
5. Product families

Our research interviews, both nationally and internationally, identified the creation of *scalable and inter-changeable* building component *product families* as a major opportunity for the building prefabrication industry. Current '*standard catalogue*' products lack sufficient variety and transferability, whereas designed, interchangeable product families would open up the design opportunities for projects, especially those constrained by tight budgets or timeframes.

A research interview with Kent Larson, architect and design innovator at MIT, highlighted the potential that such product families could offer in the future. He imagined a future scenario where an architect could specify a compatibly sized wall panel with fully integrated technology that could slot or clip directly into a home or a school, coming direct from a technology company. Over time it would be exchanged as required. While many designers might argue that such a commoditisation of the building process is '*not architecture*', it would offer the possibility for highly customisable, adaptable and more affordable solutions for those who cannot afford or access the '*bespoke*'.

Creation of such '*open systems*' would require a

fundamental mind-shift from different sectors of the design and building supply chain and an industry body would be central to tackling this challenge.



6. Finance models

In Australia it is difficult for a first time home-buyer to find a finance solution for the construction of a new prefabricated home on their own land. It is a relatively new market sector and financial institutions have been slow to develop specific products to finance a building that – in a bank's mind – represents a risk as it isn't connected to land from day one, and could potentially be relocated in the future. By contrast, specific lending products exist in Europe as it is more commonplace to build that way.

"The irony is that when a house is being built

in a modular sense it's only in the factory for 12 weeks and then it's on site - as opposed to it being on site in various stages of an uncompleted project over a 12 to 18 month period, subject to weather damage, vandalism, robbery etc." Jan Gyrn of Modscape on ABC's Inside Business, 22 May 2011

Finance is one of the keys to unlocking the potential of the local prefabrication industry as if more people can finance quality prefabricated homes, volume of turnover will increase.

An Industry Body: Two examples from abroad

An excellent example of the role that an industry body can play is Germany's Fertighaus Welt⁴, roughly translated as Prefab World. At 15 sites across Germany, mostly on the outskirts of major population centres and accessible by public transport, these display villages co-locate a range of prefabricated housing manufacturers who showcase their various products and styles. A visit to *Fertighaus Welt's Bauzentrum* in Poing near Munich includes 54 house models that address a range of tastes and budgets, with high efficiency 'green' design at the core of all products. Co-location with competitors ensures a healthy level of rivalry as well as a maximum footfall for each of the individual exhibitors.

Closer to home, Prefab NZ is a self-sustaining non-profit body that represents the interests of a wide range of stakeholders including designers,

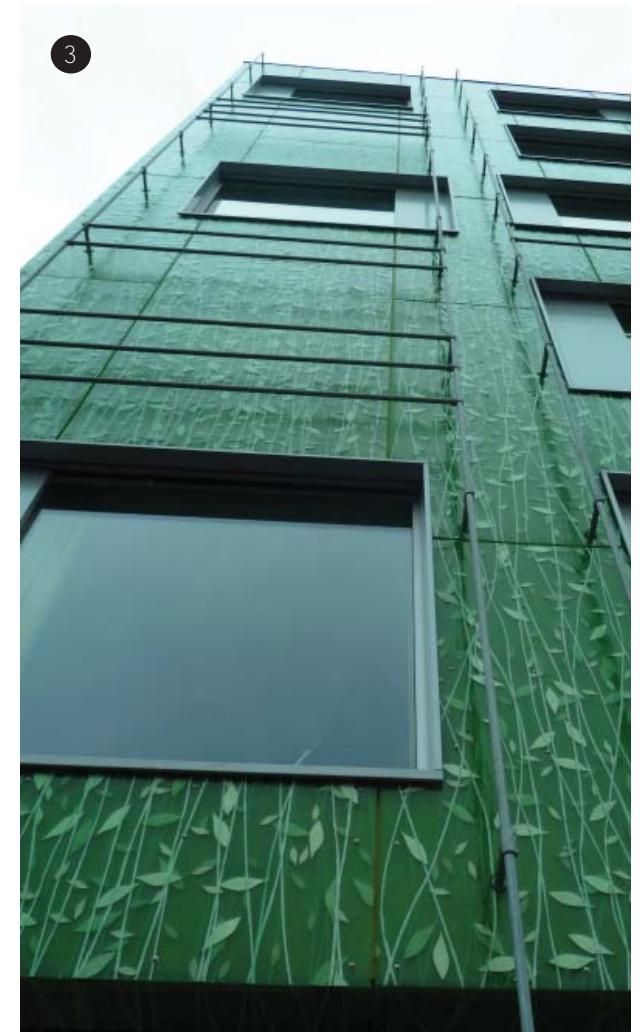
manufacturers and government. Since its formation in July 2010, Prefab NZ has been active through initiatives such as conferences, workshops and site visits hosted by members. Most recently they have established the HIVE⁵ display village of sustainable, affordable, architect-designed, prefabricated homes; a timely response to the Christchurch earthquake.

Moving Forward

How might all of this help to future proof our schools?

Prefabrication is *complementary* to traditional construction methods, *not a replacement*. A confident and active prefabrication industry would benefit Australia by offering alternatives, and through seeking more innovative and more sustainable solutions to creating our built environment. As Australia's relocatable classrooms are prefabricated, such innovation can only help to improve the quality, performance and experience of our school communities.

The challenge now is for designers, client groups and manufacturers to work together so that prefabrication becomes synonymous with quality, affordable, delightful buildings. Then prefabrication can realise its full potential to provide smart, green, appropriate and effective learning spaces for all children.



2] DaVinci House, Prefab World, Munich
3] Student Housing at Technical University, Delft, The Netherlands by Mecanoo Architecten and URSEM BV

4. <http://www.fertighauswelt.de/musterhaeuser/ausstellung/muenchen/index.html>

5. <http://www.prefabnz.com/Hive/>

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Made to Measure: Architecture or Not?

by Tom Kvan



An age old struggle in architecture is the extent to which it is understood to be a service to society versus the desire for it to attend to bespoke jewels in the interest of the client. Clearly, in designing an urban building fronting onto a busy street, such as that of an office building or a hospital, the role of the architect must be understood to be working in the interests of the clients (both those paying the bills and the users and occupants of the building) while attending to the public good. In part this is covered by the understanding that a key responsibility of a professional is to ensure that the good of the community is not compromised by the individual gain of a client.

It is perhaps self-evident then that the contribution of the architect in large projects such as those of major buildings is an important one. Design is seen in such projects to carry with it benefits for the occupants, the owners and the community in which the project is sited. That good design has social and community value underpins the establishment of such entities

as the Commission for Architecture and the Built Environment (CABE) which was active in Britain from 1999 to 2011 as the British government's advisor on architecture, urban design and public space. Thus, architecture is not only about health and safety, the basis on which it is a licensed title and protected profession in many countries. We recognise the value of design in architecture as extending beyond this threshold concern and acknowledge that design adds to the quality and dignity of life.

Consumers recognise this too and the market for well designed items bears testament to this. Carefully designed items are appreciated in all aspects of consumer goods, from aircraft to cars to pencils. The pleasure that we gain from using well designed goods extends well beyond that of mere functionality. Countries, such as South Korea, Japan, Denmark and Finland, have placed good design at the centre of their national economic strategies. The success of the pharmaceutical company, Novo Nordisk, is in part attributable to well-designed insulin products for

diabetics; they created growth by thinking through the diabetic's life and needs, thus producing well designed insulin delivery systems from insulin mixes through to a range of hypodermics for easy use, attractive pen systems, including special ones for the elderly called InnoLet.

When it comes to housing, however, discussion often quickly reverts to the assumption that architecture can only attend to the bespoke. This was articulated very well by one of the competition entrants who wrote:

"While attracted by the possibilities of prefabrication, we are concerned by the reduction of architecture to consumer commodity, along with the potential for sameness and inflexibility over time of a fully prefabricated product, particularly as a place of learning. Betty Crocker quickly understood that it was good business to make the mix not quite complete, and the 'IKEA effect' suggests that the requirement for a little bit of labour enhances affection for the results - the Allen wrench becomes the egg to the instant cake mix. While the act of building has always offered this same sense of connectedness to architecture, we see the process of design as having that potential in an emerging world of customized mass production." Dowling Architects, Canada

Underpinning the very significant contribution that design has made to improving the quality of life for so many is the ability to deliver well designed items

affordably. This is what Sigfried Giedion¹ referred to as the powerful democratizing force of mechanization. The introduction of robust materials, manufactured in quantity, combined with new techniques of industrialized assembly, vastly expanded the range of goods and hence opportunities available across society. The potential in building was recognised in the nineteenth century by Viollet-le-Duc² who engaged with new materials, iron in particular, and associated new technologies. In his writings in the latter half of the nineteenth century, he explored the architectural potential of iron, cast and plate, as readily reproducible components with distinctive structural properties.

The processes of mass production take many forms, most often the process is that of producing volumes of standard components. These can, in turn, be used to make many identical objects yet, as the auto industry has demonstrated, the same standardised components can support many obviously different end results. The same has been the case in the building industry for centuries – mass produced bricks, doors and windows lend themselves to many different house designs. So too, the same basic notes emitted from a piano have been turned by some composers into pure poetry.

6. Giedion, S.: 1941, *Space, time and architecture: the growth of a new tradition*, Harvard University Press, Cambridge MA.

7. Viollet-le-Duc, E.-E. and Hearn, M. F.: 1990, *The architectural theory of Viollet-le-Duc: readings and commentary*, MIT Press, Cambridge, Mass.

Mass production is often characterised as the uncontained replication of mediocrity. This may indeed be the case in housing – think of those views across London suburbs where the same house form sweeps its way, road after road, across the landscape. When considered critically, though, clearly there is untapped potential to use manufacturing techniques to offer mass customised, personalised solutions to buildings and to allow increased client involvement in the design process with minimum effect on cost. This approach adopts strategies successfully applied in product design. However within the architecture profession, there are questions about whether this '*commoditisation of design*' is architecture or not, as if commoditisation is a dirty word.

It is the introduction of some new technologies that have enabled us to unlock this potential, what we call reaching the tipping point. This change in manufacturing potential has been recognised by The Economist magazine in its April 21 2012 issue where it calls attention to "the third industrial revolution". What has made the difference is access to effective digital linking of the steps from concept to production, facilitated by parametric design systems (computer software that enables design to be driven by data) and numerically controlled ('robotic') production systems such as 3D printers. Are we hewing to the professional responsibilities and potential of architecture with a focus on the bespoke or will it be more appropriately realised through engagement with mass production for broader good?



Thornbury High School General Purpose Classroom by Luke Middleton

Being Smart and Green

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Intentions and bias of the SSE brief

by Philippa Soccio and Dominique Hes

Introduction

The intention behind the Sustainable School Environments (SSE) competition brief was to provide those interested in entering the *Future Proofing Schools Ideas Competition* with sustainability advice that addressed a broad range of issues. In return we hoped to see competition entries address sustainability holistically. Our understanding of ‘holistic’ was a suite of design ideas that could be made site specific with socio-cultural and environmental benefits.

Critically reviewing how we wrote the SSE brief became essential once we realised that few of our recommendations were adopted by entrants (Figure 1). Developing a better appreciation of how the sustainability advice was used will help us understand how and where to target specific information when publishing and advising on sustainability in the future. *How might designers be supported and encouraged to develop more holistic solutions?*

Surprise

This report examines the wording of the SSE brief as we reflect on why the lack of detail in the entries

came as a surprise. As discussed in the accompanying paper ‘Eco-badging versus integrated practice’, half the competition entries either did not address sustainability at all or only addressed between 1-5 of the 65 criteria. No single entry addressed more than 30 out of a possible 65 criteria. Although many entries demonstrated ‘good practice’, our intention was to inspire ‘next practice’.

The Audience Bias

A detailed review of how the SSE brief was written revealed a hefty 260 recommendations across nine areas of sustainability (Figure 2). The brief was targeted to a multidisciplinary audience with varying levels of knowledge around issues of sustainability. We provided explicit advice regarding watts per metre square, lux levels, air change rates, and so forth for less experienced designers as we believed that the prescriptive nature of informed advice could be used to place boundaries around the problem and assist in finding a solution.

We wanted to challenge more experienced designers and therefore provided advice embedded in either a quote, general discussion and/or an image of

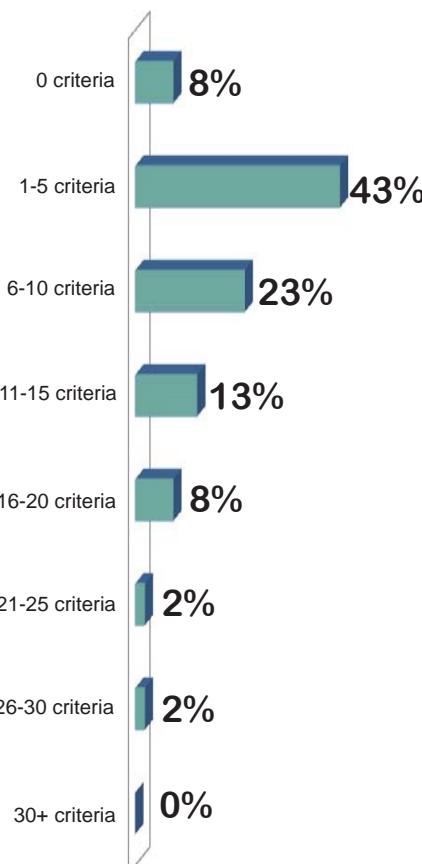


Figure 1: The number of criteria addressed (out of a possible 65) across a sample of 60 out of 119 entries

“Although many entries demonstrated ‘good practice’, our intention was to inspire ‘next practice’.”

a precedent. Implied advice in a design brief encourages the designer to use their own judgement and can lead to more creative and innovative solutions. However, this approach can also lead to design escalation, where the implied nature of the problem leads to an ever-wider definition of the problem¹.

We became more aware of our own bias when we realised that 65% of our advice was explicit. Perhaps the focus on prescriptive recommendations alienated more experienced designers or provided so much detail that designers relied on aspects they were already familiar with. In addition, our choice of sources for the advice shows a strong Australian bias (with over half from Green Star Education tool – v1) which may have been less appropriate to international audiences.

The Building Design Bias

Although our 260 recommendations broadly applied to design, construction and operation phases, our

advice focused on the building design phase. This most likely occurred because the brief was written for an Ideas Competition where *entrants were being asked to investigate ideas without needing to resolve specific detail*. Therefore, we primarily supplied recommendations that would manifest themselves in the building form.

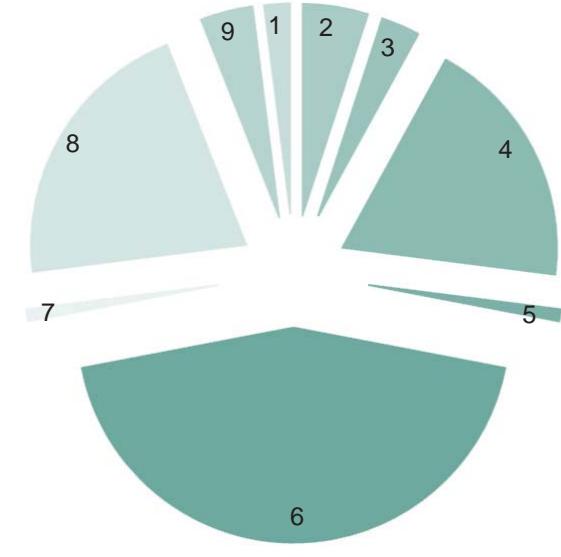
In the accompanying article ‘*Eco-badging versus integrated practice*’ and for the purpose of assessing how the entries responded to the various recommendations, we describe how we combined the similar criteria, thus reducing the total number related to building design to 65.

Sustainability component Bias

The SSE addressed issues in nine areas related to sustainability to highlight its complexity. We recognise that our approach was biased by our backgrounds. Below we discuss the main areas or components of sustainability about which we provided advice.

Sustainability Curriculum

We provided a high number of recommendations connected with the sustainability curriculum and



- 1. Heath (2%)
- 2. Biophilic (5%)
- 3. Curriculum (3%)
- 4. Energy (19%)
- 5. Fit-for-purpose (1%)
- 6. IEQ (44%)
- 7. Maintenance (1%)
- 8. Materials (21%)
- 9. Water (4%)

Figure 2: Advice provided in SSE brief

using the building as a ‘teacher’. This focus was related to a core objective of the competition as there was a unique opportunity for entrants to show how they would encourage occupants to use a building as a tool for creating sustainability-conscious citizens. The decision to place so much emphasis on using the ‘building as the teacher’ also related to our desire for more designers to adopt the idea. Future case studies will assist us to understand how our aim to use the building as a ‘teacher’ might work in practice.

1. Lawson, B 2006, *How Designers Think : The Design Process Demystified / Bryan Lawson*, Oxford ; Burlington, MA



“There is progressive thinking around the concept of sustainability that is taking it beyond eco-efficiency. We hoped to see great ideas of this nature being proposed by entrants”.

IEQ

Research into Indoor Environment Quality (IEQ) has revealed that it is a leading cause of students not performing at their best². For this reason there was a strong bias in the sustainability brief towards providing advice on improving IEQ. Parameters of IEQ are: acoustics, air quality, lighting and thermal comfort.

Biophilic Design

Biophilic design is an approach of consciously integrating aspects of and connections to nature into design. This theory promotes the importance of using nature both explicitly and implicitly in design due to its beneficial outcomes for both physical and psychological development³. Biophilic design was discussed, firstly, because both authors have a professional interest in exploring the use of biophilia as a way of moving beyond our current ‘efficiency based’ approach to sustainability. Secondly, through discussions with teachers and students, along with the authors of the ‘21st Century Learning Brief’, it became clear that the occupants of learning spaces were interested in having biophilic elements integrated into the design of their classroom. Of the 11 quotes referenced in the sustainability brief, six of these quotes are from teachers and students talking about biophilic design.

2. Ali, H., Almomani, H., Hindleh, M 2009, ‘Evaluating Indoor Environmental Quality of Public School Buildings in Jordan’, Indoor and Built Environment, vol. 18, pp.66-76

3. Kellert, S.R.; Heerwagen, J.H.; Mador, M. 2008, *Biophilic design: Theory, science, and practice*. New York: Wiley.



2

Materials

After IEQ, the selection of materials was the next biggest consideration in the sustainability brief. This section of the brief emphasised the importance of the 'three Rs' (Reduce, Reuse and Recycle), but also provided information on other less well-known areas for consideration. Compared with international designers, we believe that Australian designers do not currently specify high enough R-values. We therefore stressed the key role of insulation.

Energy and Water

Too often our current approach of providing sustainability advice is to focus on improving energy and water efficiency, overlooking other components. We made a conscious decision to only touch on these issues. This was not because we didn't regard them as important, but instead we decided that entrants would address these issues out of good practice. The minimal advice provided was targeted at the novice designers such as the student entrants.

Conclusion

The SSE brief was targeted for a multidisciplinary audience as a reference on how to address issues of sustainability in the design of relocatable classrooms. We intended the brief to be useful in the field of sustainability for both novice and expert designers. We assumed that from the SSE brief we would get solutions that were a combination of 'good practice' and 'innovation'. When we found that the general approach was for designs to use good practice only, we decided to review how we wrote the SSE brief and investigate our internal bias. This article provides a summary of our findings. By better understanding how we wrote the brief and its use by competition entrants, we aim to understand how to target specific information in future publications, aimed at assisting designers in developing more holistic solutions for 'next practice'.

- 1] Music Studio at Thornbury High School. Building design by Luke Middleton. Image by P.Soccio (2010).
- 2] Image of an underground house - Eva Lanxmeer, the Netherlands

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Eco-badging versus integrated practice

by Philippa Soccio



1] Design and image by Michael Dickson
2] Design and image by Mastura Mokhtar

“Eco-bling is environmental jewellery for buildings.”

On reviewing entries in the *Future Proofing Schools Ideas Competition*, it appeared that designers had attached green features to buildings, rather than taking more integrated and holistic approaches to include sustainability as part of the function of a building. Whether this first observation was true needed further investigation.

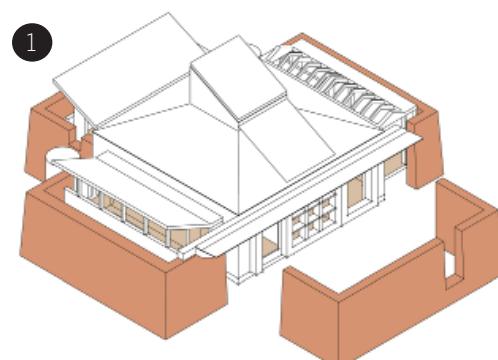
By ‘sustainability’ this article is referring to the full range of issues outlined in the Sustainable School Environments (SSE) brief, as overviewed in the accompanying article ‘*Intentions and Bias of the SSE Brief*’.

Eco-bling or Eco-badging?

When I commenced research on this article I decided to focus on ‘eco-bling’ versus integrated practice. ‘Bling’ is ostentatious, over-the-top jewellery added to an outer layer of clothing. Eco-bling is environmental jewellery for buildings.

The term ‘eco-bling’ was first coined by British Architect Howard Liddell in 2008. He used it to describe expensive high-tech sustainable solutions that are fixed to buildings as a display of their environmental credentials¹. Liddell was largely concerned with the effectiveness of small-scale renewable technologies relative to their cost and long payback periods. He argues that the investment would result in greater savings (financial and environmental) if spent on “non-glaringly obvious solutions” that can be found in good holistic design². Liddell gave an example

1. Liddell, H 2008, *Eco-Minimalism : The Antidote To Eco-Bling*, Riba Publishing, London
2. Liddell, H 2008, page 1



Example: Energy

90% of entries responded to one or more recommendations on energy. PV arrays featured in around half the entries as the single most popular idea. Passive design principles, such as stack ventilation, building orientation, insulation and thermal mass also featured highly. The integration of passive principles has influenced the building form in many of the entries.

How to use thermal mass in a relocatable classroom presents a real challenge because of the weight in transport. This entry proposed an innovative solution, which was to construct (on site after the delivery of the building) an outer shell that provided thermal mass but was independent of the system.

of how expensive this technology was. In 2008, the cost of installing a 5kW Photovoltaic array in the UK was £25,000³ which at the time converted to \$52,500AUD

In contrast, an indicative cost for installing a 4.7kW Photovoltaic array in Melbourne is now just \$12,000AUD. This represents a 75% reduction in costs in 4 years⁴. Combined with an interest in how entries use green features in addition to small scale technology, this made me question whether the conversation is actually about 'eco-bling' or 'eco-badging'.

I have focused on eco-badging which I define as a 'quick-fix' approach to improving a building's 'greenness' by assigning to it green features that aren't holistically integrated into the design. They instead appear to be 'attached' as an afterthought to meet sustainability criteria.

3. Liddell, H 2008, page 17

4. Origin Energy, 2012



Eco-badging has its place, especially in the context of upgrading existing building stock. Eco-badges can be attached to a building, independent of form and prove useful for reducing carbon emissions. However in the context of the *Future Proofing Schools Ideas Competition*, designers who relied on eco-badges missed an opportunity to showcase their best ideas for holistically integrating sustainability into their buildings. Progressive thinking around the concept of sustainability is taking it beyond eco-efficiency and we hoped that competition entrants would embed ideas of this nature.

Analysis

To more clearly understand the type of information designers were being asked to address, I reviewed the SSE brief. A total of 260 recommendations were made. Of these, 141 related specifically to building design. Through combining recommendations that were similar, for data analysis purposes, the total could be reduced to 65 criteria - still a significant number.

Example: Materials

Materials choice was either overlooked in the majority of entries analysed or referred to generically. Much of the information about material choice was gathered from the images provided where many of the textures (timber) and the use of colours referenced biophilic design.

This entry used recycled tyres as an innovative infill under the building, to build up an undulating landscape that appeared to effortlessly cross the indoor/outdoor threshold, thus connecting the building to its site.

A random sample containing 60 entries (out of 119) was then assessed against the 65 criteria. The images and text provided as part of each entry were assessed in a 'first pass' analysis to determine if the criteria had been addressed, regardless of whether it was described or demonstrated in the design. This was followed by a more detailed investigation into the quality of the ideas. The analysis was limited by the amount of detail provided in each entry and wherever possible an entry was given credit for addressing the set criteria.

Part of a more detailed analysis of competition entries involved categorising the 65 criteria as either 'eco-badges' or 'holistic'. Some of the green features that could be regarded as eco-badges include: photovoltaics, rain water tanks, attached sun shading devices, green roofs and vertical gardens, wind turbines, LED lights, energy monitors, double and triple glazing and building signage. These are generally building features that can be added to a building independent of its form. By comparison, some of green features that need to be holistically integrated are: clerestory windows for cross ventilation, thermal chimneys, building eaves, thermal mass, acoustic treatments, insulation, windows for views and under floor heating and cooling. These are generally the building features that contribute to shaping the form.

First Pass

Results from the 'first pass' analysis revealed surprisingly low levels of engagement with issues of sustainability. Half the competition entries either

did not explicitly address sustainability at all or only addressed between 1-5 of the 65 criteria. No single entry addressed more than 30 out of a possible 65 criteria.

Detailed Results

On average a competition entry addressed 7 out of a possible 65 criteria. We can only speculate that there may have been too much detail in the SSE brief, or designers focused on other aspects of the competition brief as they had just two A1 pages on which to present their design ideas. Overwhelmed, designers may have reverted back to addressing the key areas within their day-to-day practice. Given the top seven responses (see below), this may have been the case, as none of these approaches are surprising. However it should be noted that the actual implementation of a couple of these was unique and worthy of discussion.

- 47% of entries had provision for the installation of a solar photovoltaic array;

- 40% of entries designed the building with catchment areas and plumbing for the integration of rainwater tanks for watering gardens and flushing toilets;
- 38% of entries provided window shading for improved thermal comfort and energy efficiency by eliminating radiant heat load on the glass;
- 38% of entries combine high and low windows to encourage cross ventilation and illuminate the space with daylight;
- 35% of entries ventilated the space naturally using a thermal chimney and the stack effect;
- 33% of entries provided appropriate insulation in the ceiling; and
- 25% of entries provided appropriate insulation in the walls.

The top three represent ‘eco-badges’. Across the whole sample, forty percent of responses were ‘eco-badges’. Sixty percent of the sustainability solutions

Example: Biophilic Design

One of the big wins was the recurrent references made to Biophilic design through the various entries in response to the SSE brief and we were excited by how the ideas varied.

Solar PVs are so commonly seen as ‘eco-bling’ however this solution changed our perception by using them to create the roof structure which was modelled on the resting wings of a butterfly.

3] Design and image by Rana Abboud & Ewen Wright
CODESSI



were integrated, but representing good practice rather than pushing the boundaries in the way an ideas competition entry could.

This might be because eco-badges are more readily noticed on buildings or that the design teams did not describe or represent (as a graphic) how they addressed the criteria. It should be noted that the SSE brief asked competition entrants to consider a range of ideas that are less visible (such as air quality and acoustics). Whatever the reasons, the high usage of eco-badges calls for further research.

Conclusion

The competition offered an opportunity to explore the current industry approach to addressing issues of sustainability in the design of relocatable classrooms

Two main points for future research emerged. The first was a surprisingly low level of engagement with issues of sustainability. The second issue relates to eco-badging, which is improving a building’s ‘greenness’ by assigning to it green features that aren’t holistically integrated into the design.

Is this approach unique to the design of relocatable classrooms or is it indicative of the industry approach as a whole?



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Single solutions for a combined problem: A look at IEQ

by Philippa Soccio

Setting the Scene

This excerpt from my field notes describe observations of the first 20 minutes of a day inside a relocatable classroom. It highlights how the quality of the indoor environment affects our sensory experience of a space.

“As I walk into the classroom I notice the sunlight beaming into the space from the north-east and reflecting off the glossy white surface of the desks. There is a lingering smell in the room like old sandwiches and pencil sharpenings and the windows are open to bring in some fresh air. I immediately notice the sound of traffic from the nearby road.

As the students start arriving the teacher assigns jobs. One student is asked to close the windows, while another pulls down the blinds to block the glare. A third student turns on the artificial lights. The whole room is controlled by a single switch and I assume that no lighting variation is possible. The room is flooded with the white glow of the fluorescent light. Not all of the tubes illuminate and I notice that one is missing. Another tube occasionally flickers and the ballast buzzes. The lighting can be seen faintly reflected in the smart board from certain angles.

A fourth student is asked to switch on the air conditioning. The sound of accelerating cars outside was dulled by the action of closing the windows, but even this noise is now virtually eliminated and replaced with the constant hum of the air conditioning unit and the rattle of its motor.

With the air conditioning now on, I notice that student work strung across the classroom on wires, now flaps freely with the overhead stream of air. Students seated in the row closest to the air conditioning complain they are cold, while the students seated two rows back complain they are hot.

There is a pause in teaching as we hear the students in the adjoining classroom scraping their chairs across the floor as they stand up. I presume roll-call is over and the class is leaving to go outside. The floor of the whole building echoes as the students exit. There is one final bang as the door slams without a stopper. The lesson resumes...”

Defining IEQ

Indoor Environment Quality (IEQ) is the combined impact of environmental parameters such as air quality, light, acoustics and thermal comfort. Advice on IEQ made up nearly half of the Sustainable School Environments brief. We wanted to highlight the importance of good IEQ in the learning environment.

Looking through the entries submitted as part of the Future Proofing Schools Ideas Competition, I was surprised that less than a quarter of the entries addressed IEQ. Of these, the general approach was to investigate each parameter in isolation and not address how the overall IEQ would be impacted, especially with regard to flow-on effects of one decision influencing other outcomes.

It is difficult to make a judgment on IEQ quality based on drawings alone. Therefore this article is a qualitative reflection of ideas related to IEQ based on my lived experience of collecting IEQ data in eight relocatable classrooms across Australia over 12 months.

The Approach

The emerging trend in a sample of 60 competition entries was for designers to propose passive solutions. Generally, lighting was provided through daylight, thermal comfort controlled through stack ventilation and thermal mass. Acoustics were improved with sound absorbing materials and air quality maintained with cross ventilation (to prevent CO₂ build up) and by avoiding materials with VOCs.

Passive Design versus Active Design

My research is demonstrating that IEQ in existing relocatable classrooms is currently maintained using active systems predominantly rather than mixed mode or passive ones.

Passive design has an important role in improving energy efficiency. The accompanying article '*Eco-badges versus integrated practice*' commends designers who integrate passive design solutions as a first principle. However, in a learning environment, it is not realistic to address IEQ using only passive solutions, because of the very specific requirements for air quality, light, background noise and thermal comfort. Relying on only active systems is a missed opportunity as these require more energy and can create a disconnection between students and their outdoor environment.

Thermal Comfort

Thermal comfort means different things depending on the climate zone and time of the year. While competition entrants proposed using cross ventilation, few included ceiling fans to assist air circulation.

An idea utilised by a small number of competition entries was the inclusion of a fly-over roof to reduce the direct heat gain a building experiences from the overhead sun. These are already used in the arid climates of Western Australia. However the way they are used in the competition entries expands their functionality. A fly-over roof can remain on site as a permanent structure when it is no longer required as cover for relocatable buildings. The area underneath can provide a shelter for outdoor learning, while the roof structure can be used as a catchment area for rain water harvesting and as a surface for installing photovoltaics.

1] Design and image by Lisanne Havinga





Light

Clerestory windows and skylights were a popular design choice for accessing daylight without eliminating valuable wall space.

Having too much light in the classroom is as much a problem as not having enough. I was specifically interested in designs that illuminated the space using daylight, but also had systems in place to allow the occupants to control the light - to 'switch it off' when darker conditions were required. This is an example where a mix of passive and active systems complements one another.

Acoustics

Specifying soft finishes and sound absorbing materials (such as acoustic ceiling tiles) were the most common responses for addressing acoustics. Others showed more imaginative approaches to acoustics, for example the use of acoustic baffles.

2] Design and image by dKO Architecture & AECOM

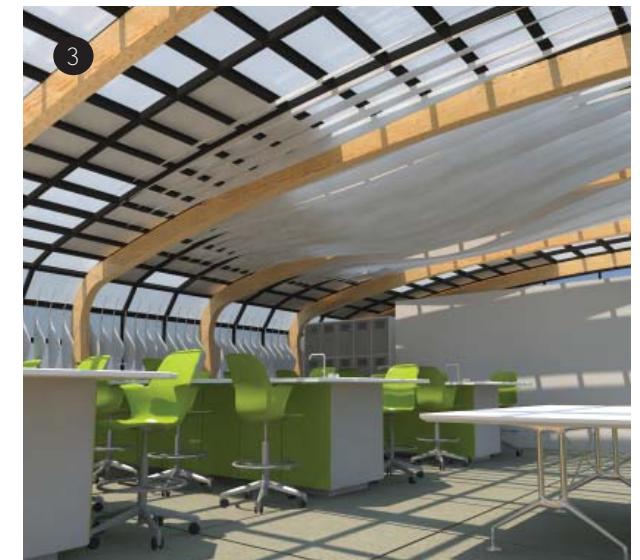
One entry proposed controlling the amount of daylight through operable, internal sails that both filter light and define spaces. This entry also used external operable louvers to block daylight.

3] Design and image by James Vaughan Maguire

One effective and pleasing solution was to use acoustic baffles to help define the internal spaces of a classroom highlighting how acoustic treatment can be both aesthetic and functional.

Conclusion

Despite Indoor Environment Quality (IEQ) being the combined impact of environmental parameters such as air quality, light, acoustics and thermal comfort, the general trend amongst competition entries was to provide a single solution for a single parameter and not consider their combined impact. It was common for a designer to propose passive solutions. This is in contrast to current practice, where relocatable classrooms use active system to achieve good IEQ. While this article describes some interesting passive design solutions for individual components of IEQ, the point I also wanted to emphasise is the importance of thinking of IEQ as the combined impact of these components and how solutions for addressing IEQ can be made interesting.





Design and image by LAVA + ARUP - Bruce Kelly, ARUP and Chris Bosse, LAVA

Learning outside the Box

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Design - for the pleasure of learning together

by Mary Featherston

1] Wooranna Prep. Grade, Victoria
Design by Mary Featherston



Over many years as a parent, researcher and designer I have had unusual opportunities to watch young people 'at play' - when they are organising their own activities. I am intrigued by their boundless curiosity about one another and the world - their capacity for imagining, creating, inventing, negotiating and mastering new skills. A 'game' may be sustained by a small group of children for a long period of time and they may be so immersed in the activity that they are oblivious to all that is happening around them - except for occasional recourse to adult assistance. It seems that these are pleasurable and memorable experiences and may be returned to again and again. Invariably they take place in informal contexts: at home, playgrounds, museums, even airport lounges. How does this relate to 'learning' in the formal context of schools?

When young people are surveyed about what they would like in their 'ideal' school they give similar responses: doing things in small groups, more active and hands-on experiences, more unbroken time, a more 'connected' curriculum, and more interesting 'organic' buildings.

These observations and ideas have led me to pursue a personal action research project over many years in which I have investigated 'progressive' schools in various parts of the world that respond to young people's curiosity and drive to learn. I have also been fortunate to collaborate with several remarkable educators in the creation of learning environments within local primary and secondary schools - from low-budget refurbishments to multi-million dollar purpose built schools. Each of these environments has a unique character in response to the particular school community, but they also share many similarities in response to beliefs about

children and learning.

Generally progressive schooling emphasises: student centred learning, democratic relationships, collaborative problem solving, experiential learning and a transdisciplinary curriculum. All of these pedagogical practices have profound implications for the organisation of people, curriculum content, management of time and design of the physical environment. Design is concerned with the containment of space (the built shell), sub-division of space and location of things in space (furnishings). In my experience there are two major determinants of design of progressive/contemporary schools: the sub-division of a school population into large, separate communities or neighbourhoods and an inquiry-based approach to learning and teaching. This differs radically from the traditional practice of single teacher, cellular classrooms for general and specialist teaching.

Inquiry based learning

Inquiry-based learning may be interpreted narrowly as 'thematic projects' or 'project based learning' (PBL) where teachers set the topic, time is limited and outcomes are predetermined. The most highly evolved pedagogy and design that I know of includes the Eveline Lowe primary school (UK 1960s), Montessori schools designed by Herman Hertzberger in the Netherlands, the schools for young children in Reggio Emilia N.Italy - and schools throughout the world that have been inspired by their theory and practice.

The processes of inquiry-led projects are dynamic,

unpredictable and share some of the intensity of naturalistic play, scientific method and the collaborative processes of design. The unique characteristics and background of each participant (students and teachers) contribute to the evolution of the project – and the group together develop skills and understandings that could not be achieved individually. Essentially the process is driven by a carefully considered 'research' question – a question that is intriguing to all participants and that has the potential to hold their interest over a long duration – possibly weeks or months.

Studying the documentation of rich inquiry / discovery projects has helped me to envisage the diversity and quality of experiences involved and the necessary supportive social/temporal and spatial environment. The environment must also support different modes of engagement: playful exploration, focussed inquiry and rigorous study. Taken together this has formed a detailed generic 'design brief'.

Generally a project will begin with a small group of students and a teacher discussing their responses to the question and attempting to resolve their conflicting hypotheses. Documentation of previous ideas will be reviewed at the start of each session before further exploration, experimentation and expression using a wide variety of media in the real and virtual realms. Crucial to the unfolding inquiry is documentation, in many forms, as a basis for discussion amongst the group, with other teachers and with parents.

A landscape of possibilities

These projects take place in various settings within a 'neighbourhood'. Each neighbourhood is home for a 'community of learners', varying in group size from 50 – 150 students together with their team of teachers. A neighbourhood is an assemblage of discrete settings interlinked to form a flowing space. The space invites movement and exploration and gradually unfolds to reveal a wide variety of social and learning settings. Articulating space in this way is intended to create a home which is open and generous but not overwhelming. Most importantly, a lively convivial environment is created where friendships can be developed within a democratic community and where students can see their team of teachers collaborating. The interior provides a 'landscape of possibilities' - a living/learning/working environment comprising a wide variety of discrete settings: intimate and spacious, quiet and active, wet and dry, light or dark, for discussing, researching, experimenting, communicating, creating, documenting, reflecting and relaxing.

Each setting is purposefully designed based on the optimal number of participants and the nature of the experience(s). Each has a particular size, degree of enclosure, relationship to adjoining settings, lighting, services, surfaces, furnishings and loose items. Each is designed to attract, engage and sustain engagement by providing 'cues' for use, by minimising distractions from adjacent activities and by placing resources at point of use. The intent is that design of the physical environment, together with periods of

unbroken time, will nurture deep and transformative learning experiences.

A seamless flow of activity

Settings are interlinked to embody the interconnectedness of all areas of knowledge and the dynamic processes of learning. Many and varied activities occur concurrently. Connectedness of settings also enables students to stay 'in the flow' of a project, moving seamlessly from one experience to another – without having to wait for the next timetabled session in a remote specialist facility. The environment encourages learning in context through melding together functions which are traditionally housed separately as general purpose and specialist spaces.

Teachers individually and as a team, can observe and interact with students in a variety of contexts, leading to deeper and richer relationships. Visual connection between areas enables one teacher to be wholly occupied with a group of students, as in a direct instruction session, whilst other staff move to facilitate where needed. Openings between settings, actual or glazed, enable all the participants to be aware of who is where and what is happening, this also encourages purposeful choice and spontaneity. Students are encouraged to develop independence and self-management in a number of ways: personal storage within learning spaces, fittings & furnishings which provide ease of access to resources and clear circulation paths for ease of movement.

Students working individually or together may

be immersed in a particular experience whilst maintaining a sense of connection to the whole group. This is achieved by the location of settings relative to one another and by various boundaries or enclosures around each setting, from minimal (change of floor surface / change of level and items of furniture) to transparent (glazed panels, walls and doors) to solid (full height walls).

The configuration of space is non-hierarchical to support and reflect democratic relationships. It also recognises the significance of the social and emotional components of learning and the value of all forms of learning: adult or student directed, passive and experiential, real and 'virtual'.

These environments are relatively permanent rather than totally flexible. Stability means that everyone knows where things are – important in a very dynamic and unpredictable program. Teachers comment that permanent settings save time and energy which would otherwise be spent in negotiating and scene shifting. Purposefully designed environments enable the development of richness and complexity over time.

Conclusion

The transformation of a school from traditional to 'contemporary' learning is challenging for all the protagonists. There is an urgent need for educators, design professionals and policy makers to learn collaboratively from the experience of existing innovative schools and to develop design processes and, I would argue, detailed generic design briefs.

1] Children playing with parts of the trunk of an Australian 'balga' (grasstree) at school in Perth. Image provided by a teacher.



1

19

Opportunity and ambiguity: unstructured and structured play in school landscapes

by Margaret Grose

All over the world, relocatable classrooms are placed in existing school grounds primarily to provide space for increases in student enrolments. Relocatables can be seen as providing many opportunities or they can be seen as visual impediments and the cause of spatial difficulties in the schoolyard. Their degree of success is due to good design or not. In our design ideas competition *Future Proofing Schools* we challenged designers to do something very odd: we challenged them to try to think about the landscape of the school in the context of these seemingly unwieldy, highly structured ‘blots on the landscape’ (as some have seen them). We challenged designers to think how relocatables might suggest positive opportunities and engagement in outdoor spaces in a school, anywhere in Australia.

Such an ambition in our whole team and Industry Partners reveals a fundamental change in how educators and designers are thinking about relocatable classrooms. This takes us beyond thinking of a relocatable as a building with particular sets of spatial and environmental performances towards also thinking about how a building is placed in the context of its school, and how such opportunities might

be approached through design. This is important because while the building’s performance, which was a major part of our design competition, is key to its success, a relocatable is experienced by students and teachers through its position within the whole school landscape as well. That is an equal key to its success.

Two-thirds of the submissions to the *Future Proofing Schools Design Ideas Competition* investigated how their relocatable could be positioned within existing school grounds and 70% considered how they might engage best with the outside. Nearly 60% considered outdoor learning and play. These ideas are all related spatially.

As an ecologist, I have a particular interest in children having opportunities to play in messy, unstructured places because of the known beneficial impacts of the availability of ‘nature play’ for children on future attitudes to the environment¹. The school, no matter how small the space, is now the most likely place for children to have such an opportunity. Looking

2] The Country School California, USA by Office of Mobile Design. Photo: Dave Lauridsen

at the image on the preceding page, those little people playing with the segmented pieces of a balga (*Xanthorrhoea preissii*) trunk will need to have a good feel for the rhythms of the natural world to make the best decisions because little children like them will be the ones to see climate change in our cities and other environments in their lifetimes. Unstructured experiences of natural spaces are therefore vital to their education.

I joined the *Future Proofing Schools* team as the odd one out – neither a primary or secondary educator nor an architect, but as a landscape architect. What on earth was I doing here with all this pre-fabrication-speak and schools education terminology? I saw that the very problem of relocatables – that they are movable – was a capacity to offer a continual reframing of their relationship within school grounds. This gives relocatables unique opportunities to provide highly structured, loosely structured, and unstructured external spaces which could be used for all types of random play or formal education.

When play at school is discussed it is often centred on games, often with a ball, or a specific activity.

1. Louv R 2005 *Last Child in the Woods: Saving our Children from Nature-Deficit Disorder*. Atlantic Books, London

Or it can be discussed at length by educators as an act of education, of learning through play, and thus spaces for play are often conceived as purposeful educational spaces or games spaces. These scenarios suggest levels of organisation. Or play can be taken as something that children discover, and they need to be given both physical spaces and time to find their own play; this scene suggests little obvious organisation. Relocatables, designed and then used smartly, can provide for both structured and unstructured playspace in a great range of environments.

With this ambition, relocatables need to be flexible, or plastic in their potential, with the potential for ease of access inside and outside. Care needs to be taken that relocatables do not intrude into and disrupt formal play spaces, but make positive changes to the school landscape. They can clear a space for new play by being a second storey overhead, they can create private nooks for contemplation, or they can provide new atypical school spaces which might be messy and overgrown for unstructured, ambiguous, non-cognitive play and chat. Such roles which a relocatable might take can positively influence the life of the school for both teachers and students.

The Competition entries have shown that our next generation of schools will be capable of engaging with the ideas and realities of unstructured and messy play to facilitate interactions, with classrooms and outdoor spaces showing plasticity of designs. For me, this is the wider picture of future proofing us towards a better relationship with our world.



20

Six Dimensions of Future Learning Spaces

by Kenn Fisher

1. Technology and Digital Natives

Both nationally and internationally, many schools are not embracing technology fast enough and this is frustrating for young digital natives. Many of us will know a 3 or 4 year old who can download games from their parent's mobile phone, laptop or tablet, so imagine how that child feels when they get to school and have limited access to their '*normal digital toolkit*'.

There is a lot of technology out there in schools but it tends to be unevenly distributed or schools are unsure how to embrace it. School laptops are often used as nothing more than word processing tools due to a lack of good wireless or technology savvy teachers.

The proposed National Broadband Network will start to address the unequal access to sufficiently fast broadband access across Australia over time, but our *digital learners are impatient for the technology now*. An interesting anecdote is that of a resourceful and proactive local student who brought in a mobile broadband device from home, plugged it in to his school laptop and could provide the class with a faster connection than was available via the school internet.

The biggest change in the next few years will be a *young cohort of teachers* entering the workplace who are *digital natives themselves*, who will understand and engage with technology, and will work towards *completing the technology transformation in education*. A big hurdle will be that the majority of learning environments are still designed to a 19th century model and a pre-digital way of doing things. We'll need to create physical environments that support this change and don't hold it back.

2. Learning Hubs

Learning hubs will play a major role in the future learning landscape. The idea of learning hubs, which could also be described as specialist centres, is certainly not new but we now need to activate the idea and use it more strategically.

The primary catalyst for this change will be to break away from the 19th century 'factory' model of education and the need to create more 'realistic' or authentic learning experiences for our students. These learning hubs would work at an individual school level but also have the potential of working at an inter-school level. The key strategy here is to bring the resources within close reach of the learners, rather than have the learners move from building to building to access them. This is the thrust of the CDIO (conceive, design, implement, operate www.cdio.org) concept in engineering which is, in hindsight, the framework used for the problem-solving based Australian Science and Maths School.

At an *individual school level*, these hubs cluster certain facilities that have a cognate discipline focus such as a technology hub, a science hub, a humanities hub and performing arts hub. Students will have a destination for a particular range of activities and all the resources they need will be at their finger tips.

At an *inter-school level*, these hubs have the potential to become something quite exciting for secondary school students. Imagine a learning hub embedded at a local zoo, at nearby wetlands, within a local manufacturing hub, or at a local footy club - again with all the resources and necessary support co-located. This model takes the students out of the traditional school environment and into a 'controlled' or

“The biggest change in the next few years will be a young cohort of teachers entering the workplace who are digital natives themselves... and will work towards completing the technology transformation in education.”

managed version of the real world. These approaches are used sparingly in Australia but are extensive in England and Scotland.

3. Learning Clusters

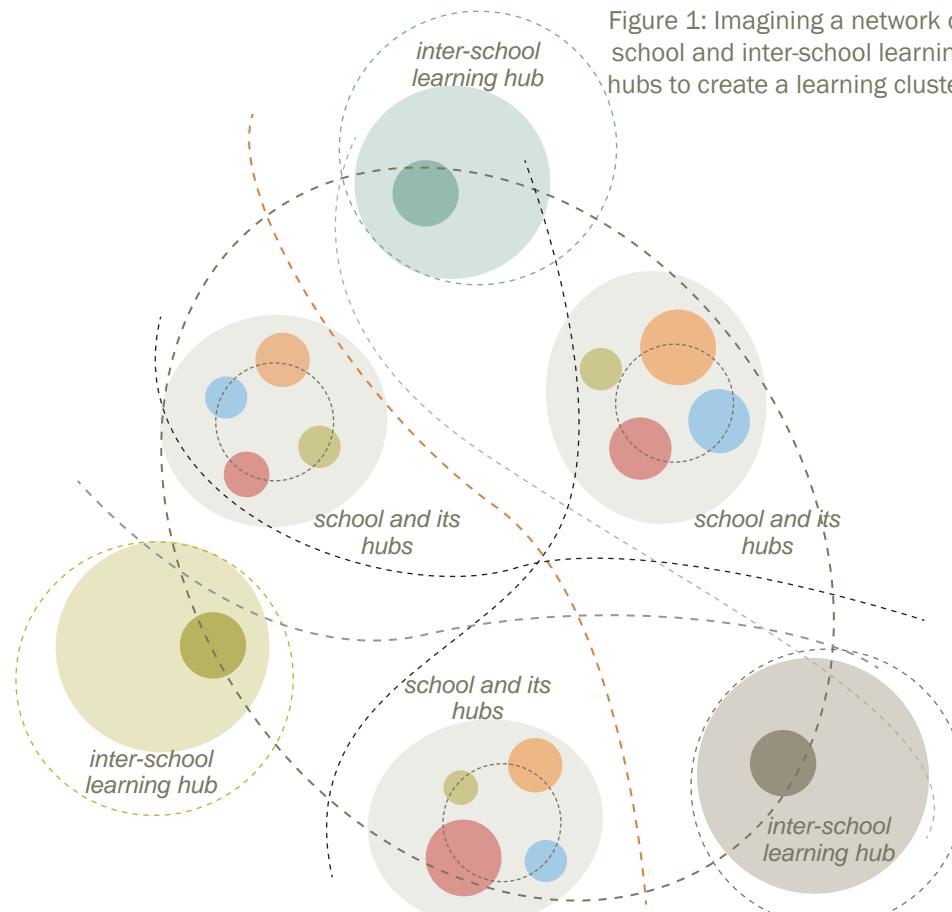
In 25 years time, how might schools be different?

What if a student enrolled in a cluster of schools rather than an individual school? This inter-school model is a fundamental shift in culture. Issues such as *duty of care* for under 15 year olds, *ownership models* and *funding models* would need careful consideration, consultation and resolution. A sense of school community ownership is critical to this model, so a cluster of schools would need to negotiate what and how they shared certain resources - particularly those ‘off-campus’ – and where students might be located during the course of a day or a week.

It’s essential to start from a school’s role at the heart of community. The learning hub model offers clues about how we could create clusters of social capital that blur traditional boundaries rather than considering a school as such a finite entity. This sets up some interesting new dynamics both virtually and geographically. At the centre of a cluster might be a network of dynamic resource hubs that are embedded in the community and support teacher, students and parents; a library plus.

The clusters would need to be tuned into the socio-economic demographic of their geographical area, and different schools would need to examine appropriate pedagogical approaches to suit diverse student cohorts.

Figure 1: Imagining a network of school and inter-school learning hubs to create a learning cluster



“Perhaps it’s time to strategically rethink how we might better use this agile, relocatable infrastructure. They have the potential to evolve into something quite different in the future.”

4. Libraries

In this future model, the library takes on a more central community role. Rather than shrinking or disappearing in the future, the community library and school library might merge and evolve into something bigger and wonderful, linking both the virtually and the physically dispersed hubs.

In areas facing unemployment, ESL or literacy challenges, parents who so wish could become co-learners. There are excellent examples of this in Broadmeadows where traditional notions of libraries are being deconstructed *in a positive way*. The model integrates literacy and numeracy skills, language skills, digital literacy, health and nutrition, and kitchen gardens in facilities co-located with child care and primary schools. The parents can follow a unique curriculum within the same hours as their children, at an adjacent location, rather than these parents feeling disenfranchised at the school gate.

Elsewhere, these libraries might be coupled with a range of more specialist, core and out-of-hours facilities, for example performance hubs, media labs or sporting hubs.

5. Smart, Temporal Spaces

The core plus model was developed for providing permanent spaces for a core number of school students, and the relocatables were supposed to address the spikes in student population. Yet we know that very often these relocatables tend to remain and become ‘permanent’. Because of this, there has been a recent DEECD trend towards masterplans that locate both the permanent and the relocatable

buildings. Traditionally, relocatables are generic spaces that lend themselves to theory type spaces, and are finite boxes to contain 25 students or multiples thereof.

Perhaps it’s time to strategically rethink how we might better use this agile, relocatable infrastructure. They have the potential to evolve into something quite different in the future.

The new *prefabricated learning environment* or PLE could be more about extension and enrichment of the school programme; highly sophisticated, specialist spaces that ‘plug-in’ to existing school facilities. PLEs could become part of the inter-school learning hubs, positioned at the wetland, the zoo or the footy club. They could be positioned near a manufacturing facility to support apprentices, or in the courtyard of a higher education institution for an immersion experience.

This leads to *temporal considerations*, and perhaps we need to develop *suites of PLEs* that are destined to be located for different periods of time. For example, weeks or months might be short term, and periods from 12 to 24 months onwards might be medium term.

6. People

When talking about learning environments and their design, it is essential to remain focussed on the impact they will have on people. The impact extends well beyond just teacher and student who are the primary occupiers, but also the entire school community and the greater community.

Teachers are time poor. Both schools and teachers struggle to shift their curriculum from traditional to on-line mode, however there is little funding or time allowed for them to do this.

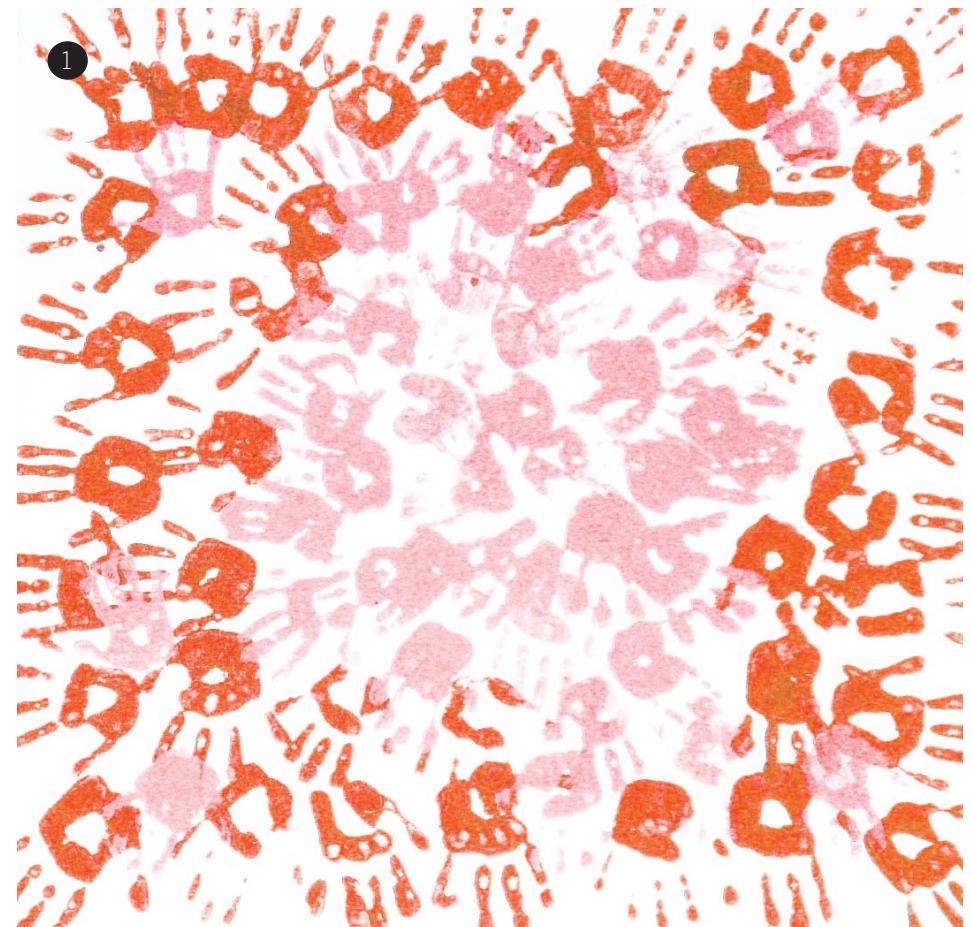
The K-12 model with all levels in the same campus is a great model for mentoring and peer learning, both for the students and for the teaching staff. This is best supported through a 'schools within school' model, where the stages of learning are designed for in the physical environment, including buildings but also age and stage related playgrounds and outdoor rooms for learning.

In this context, given that multi-literacies and Gardner's multiple intelligences are critical, the idea of spatial literacy should be embedded in the school organisation, pedagogy and curriculum. A school environmental committee could have student representation from the SRC and could consider not only issues such as sustainability but also gardens, shade and shelter, sculpture and artworks (a memory wall by graduating students), furniture, informal and social learning spaces, colour and materiality in the school. Rather than see the school as a fixed object, it should become a learning technology and seamless with the ICT's so that the virtual and the physical interact. But we need to spatially combine these virtual and physical opportunities to optimise the learning experience.

Lastly, one of Australia's most innovative educational architects once asked me – why do educational briefs and educational plans and specifications never mention fun.....

Learning should be fun!

1] Student artwork



Where to from here?

21 Recommendations for the future

by Clare Newton with the Future Proofing Schools researchers

21

Recommendations for the future

by Clare Newton with the Future Proofing Schools researchers

What do utilitarian prefabricated classrooms taking up precious playground space ‘tell’ school students and teachers about how Australia values education? There are improvements in the design and location of relocatable buildings but governments, education departments and prefabrication manufacturers are not yet fully exploiting the design, construction and sustainability potential of prefabrication.

We argue that ‘temporary’ is not an excuse for lower quality as prefabricated spaces accommodate hundreds of thousands of students across Australia. ‘Permanent Quality, Temporary Buildings’, designed to accommodate new modes of learning, will help to future proof our schools.

The competition entries give industry an array of possibilities for the design of future prefabricated learning spaces. They form a rich palette of ideas, from the quick to implement to the more speculative, that education departments might develop further in discussion with designers and prefabrication manufacturers.

We therefore focus the concluding ten recommendations on ‘how’ to take the next steps rather than ‘what’ future schools might be like.

1

The widespread use of temporary buildings in Australian schools and their impact on the activities of children and teachers provides a case for Governments to implement Permanent Quality, Temporary Buildings. It is timely to consider how these buildings might perform better in terms of accommodating 21stC learning, being more sustainable and adding to the school character.

Recommendation 1: Develop design-led solutions for Permanent Quality, Temporary Buildings that are cost effective and future proofed to accommodate evolving education pedagogies. Temporary is not an adequate justification for lesser quality.

2

In some states a quarter to a third of students are located in temporary buildings. Some of these students will be in temporary buildings for most of their schooling. If the ‘temporary’ buildings are not well designed and well positioned within the context of the school they are second-rate spaces. The impact of these buildings on outdoor spaces needs careful consideration to ensure play spaces are not compromised.

Recommendation 2: Promote careful design, selection and placement of temporary buildings to ensure better physical and cultural connections to the school context while improving the amenity of outdoor spaces and their use for play and learning.

3

New prefabrication technologies have the potential to shift the industry beyond standardised designs and processes. The transformation of prefabricated relocatable buildings also holds benefits for the design and procurement of permanent buildings in terms of quality, value for money, time and sustainability.

Recommendation 3: Consider the implications for permanent buildings if prefabrication techniques are developed to enable Permanent Quality that can be designed to suit the specific cultural, physical and climate contexts of the school.

4

Australia does not have the same level of development in prefabrication as countries such as Japan, Germany and The Netherlands. However, tipping points are occurring in Australia with new design-led manufacturers and a major Japanese manufacturer opening factories in Australia. Currently there is no industry body promoting benefits of prefabrication to clients and governments.

Recommendation 4: Encourage prefabrication manufacturers to follow international trends and form a dedicated, industry peak body to better promote, support and further develop the prefabrication industry and market within Australia.

5

With Australia-wide shortages of construction labour, exacerbated in remote locations, prefabrication will play an important future role. Continuing to innovate in the area of prefabrication will encourage investment in manufacturing technology to meet consumer needs, particularly if sectors such as education, health initiatives for remote communities, housing and the mining industry combine to their efforts.

Recommendation 5: Develop cross-sector and cross-state collaborations between client groups to encourage the Australian prefabrication industry to invest in new technologies to accommodate and drive future demand.

6

Current procurement methods prioritise facility management and sustainability rather than design and education. Government and leadership groups within Education Departments should encourage interdisciplinary collaboration to future proof design decisions. Experts in learning and teaching within Departments need to be working with the experts in facility management. Designers need to utilise the expertise of the prefabrication manufacturers and sustainability experts need to provide input along with teachers, students and IT experts.

Recommendation 6: For Government, Government Departments and Private Industry to change procurement methods to include interdisciplinary conversations in order to develop strategies which future proof design decisions.

7

Prefabricated school buildings have negative connotations within Australia. Terms such as relocatables and transportables are seen as being of lesser quality. If Departments shift toward 'Permanent Quality, Temporary Buildings', the terminology associated with prefabrication should be reviewed to counteract negative community connotations.

Recommendation 7: Terminology within the prefabrication industry needs to be reviewed to differentiate 'Permanent Quality' prefabricated buildings from lightweight, utilitarian boxes commonly associated with temporary buildings.

8

Our research of current prefabricated classrooms is indicating that active systems are commonly used to achieve comfort in terms of lighting, acoustics and air quality. There is potential to incorporate new materials, passive systems and construction strategies as well as designing more holistically to achieve high quality indoor environments with cheaper life-cycle costs.

Recommendation 8: For new temporary spaces to better link active and passive strategies for ensuring user control and high quality, comfortable indoor environments.

9

The construction industry will become more efficient as computer-aided manufacturing becomes increasingly affordable. Off-site construction in controlled environments will improve accuracy and allow more complex design solutions, efficient use of materials and sustainable design along with easier client customisation. Involvement by the client in selecting options to suit their site and client group will become viable with the potential for makeovers as buildings shift from one site to another.

Recommendation 9: Utilise developments occurring internationally in off-site manufacturing and mass customisation, learning from precedents in other industries.

10

As prefabrication methods evolve using computer-aided design and manufacture, there is a potential to involve end-users more actively in the design of the relocatable buildings.

Recommendation 10: Develop ways to involve end-users in the design, development and selection of temporary buildings to meet the individual culture and context of the school community without compromising the efficiency of future inter-school moves.



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The views expressed herein are those of the authors and are not necessarily those of the Australian Research Council.

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Further Information

To stay updated with the Future Proofing Schools research please refer to:

www.futureproofingschools.com

For further information on the research please contact Clare Newton:

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Research Investigators

The *Future Proofing Schools* ARC Linkage Grant was awarded to:

- Associate Professor Clare Newton (Lead Investigator)
- Professor Tom Kvan [CI]
- Dr Dominique Hes [CI]
- Dr Margaret Grose [CI]
- Dr Sue Wilks [PI]
- Dr Kenn Fisher [PI]
- [CI] Chief Investigators
- [PI] Partner Investigators

Research Assistants & APAI

The *Future Proofing Schools* research team has been coordinated by:

- Sarah Backhouse, *prefabrication*
- The research team also includes:
 - Lena Gan: *pedagogy & ICT*
 - Philippa Howard: *PhD student (APAI)*
 - David Lister: *parametric design*
 - Jacqui Monie: *landscape architecture*
 - Alissa Raj: *team support*

Our Industry Partners

Future Proofing Schools acknowledges its Industry Partners:

- Department of Education & Early Childhood Development (VIC)
- Department of Education & Training (WA)
- Department of Education & Training (NSW)
- Department of Employment, Education & Training (NT)
- Department of Education, Training & the Arts (QLD)
- Catholic Education Office Melbourne
- Office of the Victorian Government Architect
- CEFPI (Australasia)
- Hayball Architects
- Mary Featherston Design
- TeeCh Project
- Rubida Research

The Competition Jury

Future Proofing Schools acknowledges the contribution by the Competition jury:

- Jill Garner, The Associate Victorian Government Architect
- James Timberlake, Kieran Timberlake, USA
- Arie van der Neut, HVDN Architecten, The Netherlands
- Gini Lee, Professor of Landscape Architecture, The University of Melbourne, VIC
- Leanne Taylor, Director of Planning and Infrastructure, DET, NT
- Lee Callum, Executive Director, Stratedy, Planning + Performance, DET, QLD
- Tim Fitzgerald, Director of Wannick Unit, DEECD, VIC

Sponsorship of Competition Prizes

Future Proofing Schools acknowledges the Competition prize sponsors:

- Professional prize categories: Melbourne School of Design
- Student prize categories: Civica Education

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