

# DESERT KNOWLEDGE CRC

Housing for livelihoods:  
The lifecycle of housing and  
infrastructure through a  
whole-of-system approach in  
remote Aboriginal settlements

Kurt Seemann  
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The Desert Knowledge Cooperative Research Centre is an unincorporated joint venture with 28 partners whose mission is to develop and disseminate an understanding of sustainable living in remote desert environments, deliver enduring regional economies and livelihoods based on Desert Knowledge, and create the networks to market this knowledge in other desert lands.

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# Contents

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Tables	IV
Figures and graphs	IV
Shortened forms	V
Executive summary	1
Introduction	5
<b>Part 1: Research scope and response</b>	<b>7</b>
Dimensions of housing and infrastructure need	7
Current housing and infrastructure processes	8
Research response	12
Conceptual framework	13
Theoretical approaches	21
Theoretical synthesis in the conceptual framework	26
<b>Part 2: Lifecycle model development</b>	<b>29</b>
Background and context	29
Lifecycle model development methodology	30
Model development	31
Review of Asset Management theory	32
Review of existing model condition indices	37
International modelling	42
Australian Remote Housing models	46
Housing data	49
Development of new model condition indices	58
Software tool development	61
<b>Part 3: The Housing Stories approach to evaluation</b>	<b>73</b>
Housing and infrastructure evaluations	73
The Housing Stories approach to evaluation	78
Housing Stories research questions	79
Housing Stories methodology	81
Participatory methods in Aboriginal Australia	85
Participatory methods tool box	88
Community partnerships	93
Validation of participatory methods	95
<b>Part 4: New thinking for sustainable investment in desert settlements</b>	<b>97</b>
Knowledge gaps, emerging learning and new thinking	97
Key Dimensions for Change	98
<b>Part 5: A revised value proposition for desert settlements</b>	<b>111</b>
Revised value proposition	111
Keystone strategies	112
Synthesis	113
Conclusions and recommendations	116
References	119

## Tables

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Table 1: Trained occupations by impact on housing repair status	18
Table 2: Tools and hardware most used by house-user versus council housing repair depot	18
Table 3: International comparisons of Indigenous housing	45
Table 4: Data sources	51
Table 5: Funding for settlement housing	58
Table 6: Levels of participation	83
Table 7: Conventional versus participatory evaluation	87
Table 8: Tools for facilitators and researchers	89

## Figures and graphs

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Figure 1: Technical function by degree of local Aboriginal participation	15
Figure 2: Gender by technical function	16
Figure 3: Pattern of housing materials found among remote, small settlements	17
Figure 4: Repair and importance ratings of hardware in remote Aboriginal settlements	19
Figure 5: Conceptualisation of the Lifecycles Project	26
Figure 6: Remoteness map of Australia	29
Figure 7: Aridity map of Australia	30
Figure 8: Asset management strategies for building components with different failure probabilities	33
Figure 9: Data-to-understanding conceptual diagram	49
Figure 10: Proportion of public housing properties maintained by trade (2004)	53
Figure 11: Distribution of known dwelling age for sample settlement properties	54
Figure 12: Proportion of properties repaired by trade (2000–2004)	55
Figure 13: Proportion of properties maintained by trade (2004)	55
Figure 14: Average amount expended per property by trade (2004)	56
Figure 15: Comparison of settlement and NT public housing of properties maintained by trade (2004)	56
Figure 16: Comparison of settlement and public housing maintenance visit cost and frequency	57
Figure 17: Concept model of the Lifecycle software model under development	61
Figure 18: Database diagram for the SQL database currently supporting the application	62
Figure 19: Entry point for the assessment	63
Figure 20: Hierarchical tree	63
Figure 21: Output categories	64
Figure 22: Output selected	65
Figure 23: Condition tab	65
Figure 24: Component assessment	66
Figure 25: Investigative functionality: Immediate repairs	67
Figure 26: Budgeting for identified repairs	67
Figure 27: Total costs of portfolio management	68
Figure 28: Estimate of future costs over the lifecycle	68
Figure 29: Future cost scenario capability	69
Figure 30: Summary page with housing quality index	69

## Shortened forms

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ABS	Australian Bureau of Statistics
AEL	Allowable Expense Level
AHURI	Australian Housing and Urban Research Institute
AIHW	Australian Institute of Health and Welfare
AIS	Asset Information System
ARIA	Australian Remote Indigenous Accommodation
ATSIC	Aboriginal and Torres Strait Islander Commission
ATSI	Department of Aboriginal and Torres Strait Islander Services (Australian Government)
ATSI-HEB	Aboriginal and Torres Strait Islander Services Housing and Environment Branch
BAMS	Building Asset Management System (Northern Territory)
CAT	Centre for Appropriate Technology
CDASCA	Department of Community Development, Arts, Sport and Cultural Affairs (Northern Territory)
CHINS	Community Housing Infrastructure Needs Survey
CHIP	Community Housing and Infrastructure Program
CIAS	Community Information Access System (Northern Territory)
CMHC	Canada Mortgage and Housing Corporation
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DFID	Department for International Development
DIAND	Department of Indian Affairs and Northern Development
DIPE	Department of Infrastructure, Planning and Environment (Northern Territory)
DIY	Do-It-Yourself repairs and maintenance
DKCRC	Desert Knowledge Cooperative Research Centre
ECHS	English Housing Condition Survey
FaCS	Department of Family and Community Service (Australian Government)
FaCSIA	Department of Family, Community Services and Indigenous Affairs (Australian Government)
FCI	Facility Condition Index
FHBH	Fixing Houses for Better Health
GST	Goods and Services Tax
GUI	Graphic User Interface
HSCI	Housing Stock Condition Index
HUD	Department of Housing and Urban Development
ICHO	Indigenous Community Housing Organisations
IHA	Indian Housing Authority
IHANT	Indigenous Housing Authority Northern Territory
IHBG	Indian Housing Block Grant
KPI	Key Performance Indicator
NAHS	National Aboriginal Health Strategy
NSW	New South Wales
NT	Northern Territory
NTG	Northern Territory Government
PME	Participatory Monitoring and Evaluation
PRA	Participatory Rural Appraisal
SCU	Southern Cross University
SGS	Spiller Gibbons Swan
SOMIH	State Owned and Managed Indigenous Housing
SQL	Structured Query Language – used in database development
TBL	Triple Bottom Line – success measures that value financial, social and environmental outcomes of an enterprise
TBL+1	Triple Bottom Line with good governance added as a success measure
USA	United States of America
VET	Vocational Education and Training
WA	Western Australia



# Executive summary

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This study set out to review work to date on sustainable investment in desert settlements, reporting on extending the lifecycle of remote, particularly Aboriginal, settlement housing and infrastructure relative to social, technical and economic investment. We aimed to synthesise emerging understandings, articulate new thinking in relation to these understandings, and develop keystone strategies for exploring new ideas in the next stage of research. The main thesis of this project is that technical and economic considerations alone are inadequate for developing innovative responses to expressed need. Key factors for success are local end-user experiences and the capacities of desert people in their social contexts, and how they can enhance technological decision-making, so as to extend the life of housing and enhance investment sustainability.

Our work was underpinned by the theoretical frameworks of the Total Capital Model, Socio-Technical Systems, Ekistic Theory and Technacy. In the whole-of-system approach we used the goal was a sustained contribution to the local livelihood outcome of housing for settlements. The study confirmed that this approach was an appropriate framework to understand housing and infrastructure issues in remote Aboriginal settlements, and a wide range of stakeholders and desert communities have strongly supported this research and the approach we took to address the issues that affect and can improve the lifecycle of houses and associated infrastructure.

We completed a number of research tasks in this work, including reviewing housing data and systems and other related literature, and analysing data for lifecycle model development. We conducted fieldwork with remote settlements, gathering the views from remote Aboriginal settlement residents and representatives predominantly in central Australia and from officers of the relevant departments of the Northern Territory Government. We examined relevant social, technical and contextual factors affecting the life of remote housing and associated infrastructure, noting broader social factors such as general community health and wellbeing (although they were outside the scope of this research).

Our central finding was that social housing success can be measured by its investment reach into the local fabric of settlement livelihoods, rather than on shelter and health alone. We refer to this position as the *Housing for Livelihoods* approach. We found that the housing and infrastructure lifecycle system in remote settlements suggested a high potential for livelihood benefit to local end users, but that this potential was well under-realised.

Key issues that appeared to most substantially affect the lifecycle of housing and infrastructure included, but were not limited to:

- concerns for a lack of desert standards informed by principles of end-user demand that would stimulate climatically and socio-economically appropriate design and governance
- a dearth of programs to facilitate local personalisation of the dwelling technology<sup>1</sup> (possibly one of the key markers of housing longevity)
- insufficient synchronisation between the design, materials and technology chosen for many houses with the supply of locally accessible and affordable house repair and maintenance resources (e.g. local access to minor tools, furniture, storage and basic plumbing and plug-in efficient appliances).

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<sup>1</sup> Technology, unless qualified otherwise, will in this report refer to industrial-physical as well as digital and creative technologies.

Further, we identified that a major issue appears to be related to curriculum relevance in years K–9 education to understanding the nature of physical technologies (there appears to be local interest to learn such content from an early age). This issue includes access to relevant education during the gap years of schooling that exist for many Aboriginal youth in remote locations between post-primary and pre-adult-vocational training in technology, and access for young adults to information regarding the engagement and maintenance trade-offs incurred by different house design and technology choices. The concern this raises is that a lack of both basic technacy education and access to post-primary schooling may reduce the opportunities to grow up with informed technology engagement for many people, relative to urban experiences. We suggest that this situation has, over many years, directly and indirectly affected the managed life of – and succession of talent required to sustain and negotiate – social housing and infrastructure. In this aspect of the ‘whole-of-system’ assessment, we agree with key technacy education recommendations in the *Report on Future Directions for Secondary Education in the Northern Territory* (Northern Territory Government 2003), but note that at the time of writing, no formal response addressing the many technology recommendations in the above report has been made.

Some key dimensions for change were identified when the research findings were analysed:

- Housing for livelihood
- Desert settlements and the triple bottom line plus one
- Investment capacities for sustainable development
- Desert performance standards and technology choice
- Services as settlement functions
- Local values and user feedback
- Talent, technacy and deep diffusion
- Networks and regions.

From the synthesis of these dimensions, the Lifecycles team developed a revised value proposition incorporating these key dimensions, but with the main focus being to connect these key dimensions for change into a more coherent whole, through the following contention:

*That the most cost-effective and impacting extension to the life of the physical capital of remote desert settlements and to the improvement of the sustainability of investment is in the introduction of technacy education in the K–9 curriculum in desert regions, encompassing the cultures and values embedded in technology, making informed technology choices and supporting inventiveness both at home and in meeting settlement functions.*

Arising from these key dimensions, the following Keystone strategies are proposed as areas of activity for the next stage of research. The Keystone strategies represent a considered response to the problems of physical settlement issues in remote desert settlements, and their whole-of-life dynamics. It is important that the strategies be incorporated in the next stage of research, and be appropriately staffed and resourced, over an appropriate timeframe, especially for participatory research at the desert community level.

**Keystone strategy 1:** Housing for Livelihood: make it a central goal of any housing delivery process

**Keystone strategy 2:** Bringing triple bottom line thinking into the development process.

**Keystone strategy 3:** Closing investment capacity gaps

**Keystone strategy 4:** Developing desert performance standards

**Keystone strategy 5:** Servicing human networks and human settlements together

**Keystone strategy 6:** Understanding local values

**Keystone strategy 7:** Turning around under-developed local talents in technologies and innovation

**Keystone strategy 8:** Extending lifecycle analysis from settlements to regions

We strongly recommend that these Keystone strategies be at the forefront of future research.

The knowledge gained from this research has the potential to significantly influence housing and technical services policy, and community education policy. In addition, it will provide substantial insights into changes needed in the role and structure of government extension and education services associated with infrastructure programs in desert settlements, particularly in relation to understanding the systems requirements to deliver more appropriate and cost-effective technical services, education and housing technologies.

Further research and development remains significant to strengthen relevant technological talents in remote settlements. We identified a key opportunity for research and development in a pilot project as the need for a common, smart web-based housing management system, scaled up with routine entries and reports from point-of-service to State/Territory aggregations, that could facilitate scenarios for budget cycles for different repair and maintenance issues and report house-user feedback ratings.

The key elements of the housing lifecycle system that were identified for a potential site-based trial project include a ‘joined-up’ use of cross-government investment, where:

- housing innovations and designs foster local house-user engagement
- curriculum relevance in technacy from early childhood to middle schooling is linked to local housing design and technology
- housing programs include local hardware access to common minor householder repair, maintenance and personalisation resources
- local and appropriate regional technical service institutions or mentoring agencies are established on a similar social good basis as are the institutions for school and health services in settlements, to regard technical service programs as part of an ongoing social investment that includes fostering local participatory feedback methods
- the cost–benefits of a common online, asset management scenario tool that allows point-of-service in community repair and maintenance updates, reports of local condition comparison to regional averages, and aggregation of entries for regional and state/territory reporting are developed and tested. We found that such a tool should consider both interface design to enhance use and instant comparative reports to facilitate management and performance of local systems.

We suggest that the above principles form the basis of ‘new thinking’ and recommend further research and pilot trials based on those principles. We therefore propose that the above principles would inform a Housing for Livelihoods strategy that would more sustainably manage emerging housing and infrastructure lifecycle costs. The broad objective we suggest is to integrate the livelihoods footprint of housing investment deeper into the fabric of remote settlements through existing and emerging cross-agency mechanisms with particular attention to local K–9 curriculum, hardware retail, and online knowledge support systems.



# Introduction

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It may be argued that the substantial level of investment in social housing, infrastructure and rental assistance in Aboriginal settlements represents the most significant ‘on the books’ economic legacy these settlements could, in theory, capture to support local livelihood economies (P Taylor 2005, pers. comm., 5 April). However, housing and infrastructure programs for remote Aboriginal settlements have historically not been linked to supporting livelihood<sup>2</sup> outcomes. The level of investment has struggled to deliver a social outcome commensurate with remote community expectations. Despite investment by government, there appears to be widespread concern with the present state of affairs. The rush to try to meet housing demand, however, faces a real risk of increasing the running costs and reducing social benefits that such an increase in social housing investment could otherwise offer. It is evident that there is much room to improve the processes of settlement development as a ‘joined-up’, socio-technical system<sup>3</sup>, where housing policy is seen, not as a function or output of shelter or even health alone, but as a core conduit for supporting and widening investment for the house-user and community-livelihoods dimensions of settlement life; that is, to view housing strategies as a core means to invest in a settlement’s social and economic footprint of desert livelihoods long into the future.

To this end this study looked at both mainstream as well as ‘local’ systems to find the best ways to increase the lifecycle of housing in remote Aboriginal settlements, where housing delivery and design might better target local socio-economic impact with housing programs in the whole-of-housing systems.

To contribute to greater understanding of the complexity of the housing situation in many remote settlements, the Lifecycles Scoping Project was conceived and implemented as part of the initiatives of the Desert Knowledge Cooperative Research Centre (DKCRC). The main function of this stage one study was to establish the core components for a stage two, action-research site, for piloting ideas, informed by this report, that may extend housing lifecycles. The proposed stage two research would be delivered in partnership with a host settlement and relevant agencies over an appropriate period of time and seek to integrate, test and refine the key strategies proposed in this scoping study for wider use and application.

This report presents the findings and analysis of the Lifecycle Scoping Project of the DKCRC. To guide the reader, the report has been arranged under the following five parts.

## Part 1: Research scope and response

This part describes housing and infrastructure need and reviews current programs and processes, with some analysis of the coming structural and process<sup>4</sup> changes proposed by the Australian Government at the time of writing. This part identifies the research response of the Lifecycles team and articulates the conceptual framework for research, including the adopted theoretical underpinnings. The research activities undertaken are summarised.

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<sup>1</sup> The term ‘Aboriginal’ is used in this report when referring to the first peoples identifying with mainland Australia.

<sup>2</sup> A wider definition of ‘livelihood’ is applied in this research. While participation and engagement with the mainstream economy is an important aspect of achieving sustainable livelihoods, the term is also used to describe desired, productive, culturally based, locally valued on-country living practices. This includes knowledge, skills and technologies best placed to fit the social, economic, climatic and governance conditions of living in remote desert regions of Australia. Much of the desert knowledge, skills and technologies differ to the conditions for living in urban and coastal regions of Australia.

<sup>3</sup> A framework for viewing dynamic processes which bring social practices and technological understanding together – see **Theoretical approaches** in Part 1.

<sup>4</sup> Contemporary policy information up to July 2007 has been included where accessible to writers.

## Part 2: Lifecycle model development

Government stakeholders have requested that this research commence the prototyping of an appropriate online, centralised-data lifecycle scenario tool for repair and maintenance costs and cycles of item replacement. The tool would feature item information: site, regional and Territory-wide aggregated reports of actuals; climate effects; client experience and occupancy effects; and projected scenario and best-fit-to-set-budget scenario reports. Not having access to such a tool to fill the knowledge and policy gaps has suggested that, at least in part, housing and infrastructure delivery has been ‘flying blind’ in terms of whole-of-life costing and efficient scenario planning. This part reviews international and local experience with such tools, investigates the issues in re-developing such tools for application to desert housing, evaluates housing data typically gathered by housing agencies and settlement housing organisations, proposes frameworks for development of such tools, and demonstrates proof-of-concept through screenshots of the current status of software prototyping. A user-friendly Graphic User Interface (GUI) from point-of-maintenance entries to aggregated reporting would be developed as part of post proof-of-concept development stages in a field setting of use. In this, immediate user feedback reports are critical to driving consistent data entries of maintenance cycles as they occur at sites.

## Part 3: The ‘housing stories’ approach to evaluation

This part recognises that conventional ‘technical’ housing evaluations are usually inadequate since evaluations are almost always based on the driving parameters of the funding agencies or outside consultants rather than on the driving parameters of the house-users and local housing maintainers. Given that local value systems are often culturally different from the external value systems, it is important that local value systems around housing be identified and acknowledged, and improvement to the delivery of housing to remote desert settlements be allowed. This is a complex issue, so this part reviews the theory and practice of participatory monitoring and evaluation of development projects and assesses how such participatory methods can be applied to housing and infrastructure evaluations in remote settlements.

## Part 4: New thinking for sustainable investment in desert settlements

The analysis of, and reflections upon, the research experience are synthesised in this part, and some new thinking, which develops the idea of settlements and their regions as whole systems, is proposed. The view that social housing success is measured by its reach into the local fabric of settlement livelihoods, rather than on shelter and health alone, is described as core to the proposition of the Housing for Livelihoods approach.

## Part 5: A revised value proposition for desert settlements

In this part, the new thinking is crystallised into Keystone Strategies as a value proposition for all remote Aboriginal settlement stakeholders, and as a contribution to the current re-framing of Aboriginal housing and infrastructure delivery processes. The Keystone Strategies form the basis for a potential site-based, action-research pilot study. The objective of the pilot study is to redress tools and systems to improve housing lifecycles which, upon completion, could inform debate and ways forward in desert housing initiatives.

# Part 1: Research scope and response

## Dimensions of housing and infrastructure need

The former Aboriginal and Torres Strait Islander Services – Housing and Environment Branch (ATSIS-HEB), now absorbed into the Australian Government Department of Family, Community Services and Aboriginal Affairs (FaCSIA), has estimated that over \$3 billion would be required to meet demand for existing housing and infrastructure need in Aboriginal Australia (in urban, rural and remote areas combined), while houses were estimated as having a lifecycle of approximately 4–8 years<sup>5</sup>, depending on local factors (P Taylor 2005, pers. comm., 5 April). These figures were based on then current demographic data and did not factor in population growth. Demand for desert housing is a significant component of this total shortfall. While allocations for housing and infrastructure have increased substantially over the past ten years, the rate of expenditure falls far short of meeting the housing need. Factor in the population growth, and the long-term prospects of meeting shortfalls are more problematic.

The housing and infrastructure need is also starkly illustrated by relevant data from the 2001 Community Housing Infrastructure Needs Survey (CHINS) conducted by ATSIC (2001). A review of CHINS data aggregated for remote, discrete desert settlements (Guenther 2005) identified that 9.4 per cent of housing stock needed replacement and 14.9 per cent needed major repairs – so, almost one quarter of existing housing had reached the end of the maintenance cycle, exacerbating the demand gap even further. These results are complemented by a review carried out by the Australian Bureau of Statistics (Etherington & Smith 2004), quoting an ATSIC (2000) publication, where a shortfall of \$2.1 billion was identified – although this probably links back to data from the previous CHINS survey in 1995, and thus understates the present situation.

Recent work carried out by the Centre for Remote Health in Alice Springs (as sponsored by DKCRC, among others) looked at housing need in the Alice Springs and Central Remote regions (Mitchell et al. 2005). Reinforcing the extent of the need, the report notes that in the Central Remote region, the average occupancy, after allowance for houses requiring major repair/renovation, is 8.5 persons per house. Extrapolated to 2014, this occupancy rate produces a funding gap of almost \$340 million.

Another recent study of housing need stated that for Indigenous Community Housing Organisations (ICHOs) in remote and very remote areas, 20 per cent of the current stock requires a significant upgrade and 18 per cent requires full replacement, which amounts to a backlog of \$705 million over five years (Hall & Berry 2006). Of course, it must be stressed that this is a gap within current housing stocks and should be seen as an add-on to the \$3 billion quoted above.

Most recently, the review of the Community Housing and Infrastructure Program (CHIP) by PricewaterhouseCoopers (2007) has confirmed the extent of the shortfall in house construction to meet the needs of people in remote settlements and in the funding of necessary maintenance for existing housing.

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<sup>5</sup> This study identified that housing lifecycles are unlikely to be captured in single numerical terms. That is, housing technology represents a system of functional amenities (or sub-systems), some critical and some secondary. For example, critical amenities such as security, water and waste amenities typically dysfunction asynchronously over time. As such, house-users can and do endure periods where some of these items dysfunction sooner rather than later, but nevertheless they maintain overall user occupancy before a major retrofit or repair cycle is invoked. The 4–8 year period is thus a perceived ‘user’ estimate of tolerance as much as a maintainer’s estimate for cycles of amenity repair.

For the federal and state/territory Grants Commissions and public housing and infrastructure agencies, any clearer understanding, useful models, decision tools and new knowledge that could form the basis of innovations in services, policies and technologies with the potential to reduce the abovementioned costs by even a few percentage points, or extend the lifecycle of public housing from 8 to 12 years or more, or close the funding shortfall gap, offers a substantial value proposition. Thus, there is a compelling need for this research to investigate innovation strategies for change, particularly synergy or ‘whole-of-system’ strategies outside of the current approach to housing and infrastructure.

## Current housing and infrastructure processes

### The conveyor belt scenario

The development of remote Aboriginal settlements can be characterised as a ‘conveyor belt’ scenario, with housing and infrastructure delivered by highly codified and standardised one-way systems into often ill-equipped socio-technical environments, with a resulting ‘crash’ off the end of the conveyor. This current approach is about delivering housing units (and bedrooms) at the lowest cost and most efficiently, rather than to achieve settlement sustainability or to enhance local livelihoods. It conforms to mainstream notions of best practice, as invoked by many funding programs. Best practice delivery implies (and demands) that clients also operate best practice asset management. With housing lifecycles in remote Aboriginal settlements currently running at 4–8 years before key amenity dysfunction begins to manifest, this is unlikely to be the case.

Recent accountability-based approaches aimed at improving the efficiency of the delivery of housing units only accelerate the conveyor, because any rate of improvement in housing delivery (such as more, cheaper units of housing) is unlikely to be matched by a relevant increase in settlement capacity. The more that funding agencies focus on making up-front delivery more efficient (which is, relative to the other parts of the process, the easier part), the greater the crash at the end of the lifecycle is likely to be because the beneficiary end-users find they now have a high load of assets to manage. This in turn raises the question of how to address multiple parts of the whole-of-system cost of housing and redresses the basic question, ‘housing for what end?’ Is the end simply more shelter stock, or also better and sustainable livelihood outcomes that can manage the increased supply of new shelter technologies? While some stakeholders may be aware of this problem, any awareness does not appear to have informed housing or local educational processes to any great degree. Recent debate about problems of Aboriginal housing has rarely appeared to have considered a joined-up view of the issues.

In effect, the historical pattern of the way housing and all associated technologies and conventional adult skills training have poured into desert settlements has contributed significantly to the current situation of increased settlement fragility<sup>6</sup> and limited settlement capacity to thrive.

This conveyor belt scenario arises from the fact that stakeholders who fund and deliver housing and infrastructure are overly focused on the housing product as quantum-of-unit output and not on processes encompassing whole-of-life thinking or the context of settlement talent where the outcome of housing strategies is enhancing livelihoods.

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<sup>6</sup> The term ‘fragility’ (and its alternate, ‘resiliency’) in this report intends a view where settlements have sufficient redundancy systems (socially and technically) to accommodate temporary break down or dysfunction of key technologies, operations and services. For example, if a main water tank fails, a system of secondary water sources can be activated within reasonable timeframes. Succession of lead personnel for key social and organisational roles is also a key feature of fragility/resiliency. For example, if a work unit leader is away or leaves, others are equipped to adequately carry on those roles.

## Current programs and processes

Because the purpose of this research project is to articulate new and more sustainable ways of settlement development, it is important to understand existing processes of housing and infrastructure development, and the different contexts in which housing and infrastructure programs are delivered.

Contexts vary widely: physical environments, degrees of remoteness, legal structure of the settlement, and governance jurisdictions. While, ultimately, most funding for settlement development comes either directly or indirectly from the Australian Government, processes differ from settlement to settlement.

Direct federal funding for housing and infrastructure usually comes via the National Aboriginal Health Strategy (NAHS) funding program, as the major component of the Community Housing and Infrastructure Program (CHIP). The background to the purpose, structure and process of CHIP can be found in *The Best Way Forward – Delivering housing and infrastructure to Indigenous Australians: Community Housing and Infrastructure Program (CHIP) Review Issues Paper* (2006).

NAHS has been in operation since the mid-1990s and is managed through appointed program managers for each state and territory. In an effort to make substantive changes in short timeframes, NAHS funds, in a one-off package, ‘big-ticket’ settlement items such as sewerage schemes, roads, water supplies, major housing upgrades and large tracts of new housing. NAHS, over the last ten years or so, has become very effective at delivering housing and infrastructure units as up-front investment in physical capital. The question of whether such units meet the needs of remote settlements, or deliver outcomes commensurate with program goals has been recently evaluated (PricewaterhouseCoopers 2007); such programs were found to deliver outcomes significantly different from program goals.

In addition to such programs, indirect funding (largely allocated GST funds) is channelled through state and territory governments for a range of infrastructure purposes, but generally in substantially smaller allocations.

Funding through the states and territories is generally via state and territory housing departments, and typically through a specialist Aboriginal housing branch (such as in Western Australia and New South Wales). Often the ownership of such houses is retained by the housing departments, and not devolved to settlement ownership. Such houses are usually not located in discrete Aboriginal settlements, but are located in fringe township/suburban locations, or scattered around urban environments. Aboriginal residents are tenants of the relevant government housing department, as per the usual practices of mainstream public housing.

There are instances where such housing is handed over to settlement council ownership (as in the Northern Territory) or to the ownership/management of Indigenous Community Housing Organisations (ICHOs). The majority of NAHS-based funding is directed towards discrete settlements where the product is handed over to settlement control, as is the majority of housing funding in the Northern Territory. Queensland has a mix of allocations to ICHOs and department-managed housing. There are also differences depending on degrees of remoteness: housing in urban and rural areas is more likely to be managed by housing departments, whereas housing in remote areas is under settlement ownership and/or management. The desert areas of Australia also encompass the majority of discrete settlement-managed housing (Hall & Berry 2006).

## Problems with current processes

The issues of settlement-owned and -managed housing already outlined illustrate the conveyor belt scenario further: the delivery side is driven by the need for accountability through best practice project management, but once handed over to settlement control, there is varied, and usually limited, capacity for such management. The irony of the situation is that the more effective the delivery side becomes, and the more housing and infrastructure delivered, the greater is the gulf between what the settlement can realistically manage and the actual workload. Hence, the crash off the conveyor belt, which is felt most strongly in the remote desert regions of Australia. As a result, this research largely focused on settlement-managed housing in these regions.

One key factor in Aboriginal housing programs is the lack of lifecycle analysis, and the use of such analysis to inform the funding allocation process for capital, recurrent and socio-technical system funding. A recent Australian Housing and Urban Research Institute (AHURI) report (Hall & Berry 2006) investigated capital and recurrent maintenance funding for housing managed by both State Owned and Managed Indigenous Housing (SOMIHs) and Indigenous Community Housing Organisations (IChOs). In addition to confirming the large and growing funding gap for meeting housing need, it also recommended that:

*The issue of capital versus recurrent funding suggests that capital budgets should be determined on a full life-cycle basis, with adequate provision made for major upgrades.*

(Hall & Berry 2006)

Few, if any, reports, including the above report and the findings of this research study, have recommended wholesale changes to the housing system. While the challenge to the existing system and proposals for complete restructure are outside the scope of such research, independent research by bodies such as AHURI and DKCRC propose new thinking that can be taken up by the political system at its discretion. However, this limitation of scope was no obstacle for the recent review of the Community Housing and Infrastructure Program (CHIP) by PricewaterhouseCoopers (2007).

### *The CHIP Review*

This report was commissioned by the government department responsible for the overall Aboriginal housing system, the Federal Department of Families, Community Services and Indigenous Affairs (FaCSIA), to carry out a complete review for the decision-makers. Their review was so critical of the process of Aboriginal housing delivery that its main recommendation was:

*... that the Community Housing and Infrastructure Programme (CHIP) be abolished and replaced with a new strategic approach to Indigenous housing in remote areas and urban/regional centres.*

(PricewaterhouseCoopers 2007, p. 23)

The strategies proposed under the new approach are a mixture of radical (and welcomed) changes to the structure of funding, some new ideas about the nature of remote area housing (such as private ownership on settlement title) and, surprisingly, a recycling of much of the same language and rhetoric used in existing programs, particularly around maintenance, employment and training. The review is excellent at identifying the structural problems of the funding process, shortfalls in funding relative to need, and the mismatch between program rhetoric and subsequent outcomes for Aboriginal people. This goes some way towards explaining why the CHIP review recommends settlement-owned housing be handed over to state/territory housing departments (or private ownership) as a pre-condition for repairs and maintenance funding.

Another new feature of the proposal is to create incentives to encourage people in remote settlements to re-locate to larger, more urbanised centres. Combined with the recommendation for no further housing funding on homelands and outstation housing, there is the potential to ‘empty out’ remote desert settlements. Removing local services in small settlements and centralising them into fewer but larger regional centres may appear economically attractive; however, the social impact of this approach and any consideration of opportunity costs have not yet been thoroughly examined. This issue of relocation is discussed later in **Part 4: New thinking for sustainable investment in desert settlements**.

Much of the detail in the report is essentially the ‘low-hanging fruit’ response. Certainly, the recommended increase in funding will have an impact. However, in its prescriptions for change beyond the structural, it falls into similar patterns as historical programs: prescriptions for better management, competitive tendering, regional project management, better supervision of construction, more urban-based training, creating more employment through housing delivery and maintenance, and targeted maintenance programs.

Particularly concerning is the recommended three-year ‘blitz’ approach to maintenance and upgrades. While it is natural that an Aboriginal family whose house has just been blitzed would welcome this approach, the outcomes would be ‘business-as-usual’ if such a blitz were not instituted as the first step of a whole-of-systems, sustainable, lifecycles-oriented approach.

The CHIP review is short on detail about the extent of consultation. Consultation covering the whole of Australia occurred over a two-month period in 2006, but it is not clear how much consultation occurred, or at what level. Apart from occasional highlighted quotes which appear to be from settlement managers or highly placed settlement people, there is no evidence that any participatory settlement-level housing evaluation of the type recommended by this research, occurred (see **Part 3: The Housing Stories approach to evaluation**). It appears that the perspectives of the people with the greatest interest have only been included in a manner one or two (or more) steps removed.

One very key omission from the CHIP review is any detailed discussion of lifecycles understanding as a key driver of future housing processes. This is a very difficult concept to grasp, let alone apply. For this reason alone, the possibility of the new strategic approach falling into old patterns is likely.

In recent Australian Government and Northern Territory housing innovation program briefs (IBA 2006; NTG 2007), tenderers were asked to develop innovative models of housing. The federal project did not mention lifecycles (only design for ‘durability’ [IBA 2006 p. 6]), let alone a lifecycles basis as a fundamental driver. The Northern Territory Government Expression of Interest has a small section requiring tenderers to incorporate whole-of-life costs, while at the same time stating:

*... the foremost objective of this Expression of Interest is to reduce costs of construction and hence this will be a primary consideration in the evaluation of the Expression of Interest.*

(NTG 2007, p. 6)

This is a great disincentive for lifecycle-based solutions. Further, tender documents did not indicate any basis for making such decisions, or any criteria or tools for scoping lifecycles. For projects aiming to determine the future direction of Aboriginal housing (as informed by the CHIP review),

and in anticipation of the new Aboriginal housing framework, this lack of understanding of the nature of lifecycles is of great concern. It also stresses that the findings of this scoping project are relevant for the new recommended structure.

## Changes proposed by government

In May 2007, the Minister for Families, Community Service and Indigenous Affairs launched the new framework for Aboriginal housing: the Australian Remote Indigenous Accommodation Programme (ARIA). This program is regarded as:

*... the practical response to the recent independent review of CHIP commissioned by the government last year and demonstrates that at the national level we are prepared to take hard decisions and commit resources towards fixing the problem.*

(FaCSIA 2007)

As there is no detail about ARIA other than the recommendations made in the CHIP review, then the Lifecycles critique of the CHIP review applies to ARIA, until such time as more detail is forthcoming.

The new approach very strongly promotes private ownership of settlement housing. This is based on the modern urban ideal of home ownership driving economic development and prosperity – the Lifecycles research sees no fundamental problem with that position for many situations. However, the urban approach to home ownership is shaping up as another example of a technology transferred into a different context to the one in which such strategies were initially designed to operate. In relation to Aboriginal settlement housing systems, the idea is untested; there is so little research into this subject, that to build the new system around this key idea at this stage is hypothetical rather than pragmatic. The new approach is placing much hope on this as a significant contribution to change, but it has great potential for failure: for example, in some remote contexts there is potential for loan defaulters to be bailed out or evicted, only to return to public housing or to perhaps leave their settlements.

The CHIP review also identifies that such a system would hand over the lifecycle responsibility to any respective housing owner (PricewaterhouseCoopers 2007, p. 78). There is no clear mechanism for how this would work, let alone demonstrated capacity for individual lifecycle maintenance without substantial outside support. The whole-of-systems factors identified in this research apply equally to the private ownership scenario, as to the public and settlement housing scenario.

While generally supportive of the new strategic approach as proposed, this scoping research agrees with Hall and Berry's findings on the need for a lifecycles basis for Aboriginal housing, and identifies the lack of lifecycles-informed processes in the new framework as a major omission. Thus the findings of this research, although having been framed prior to the CHIP review and the advent of ARIA, are still highly relevant for a more sustainable and holistic approach to Aboriginal housing and infrastructure.

## Research response

### Key research questions at project inception

The research proposal emerged, prior to the official project proposal, through discussions with stakeholders, workshops with researchers and input from DKCRC researchers and the DKCRC Board. Several stakeholder workshops were held in Alice Springs over 2002–2003 to develop the

scope of the Lifecycles research. Early in the process it was agreed that a focus on the technology of housing and of current delivery processes would be inadequate for the development of innovation strategies. The ‘whole-of-systems’ approach received support early in the development phase, and subsequently such an approach was articulated through the following key research questions:

- What are the knowledge gaps in capacity defects with current lifecycle models using existing desert settlement information?
- How can threshold factors affecting cost critical lifecycle events be conceptualised and modelled in the contexts of the total capital of desert settlements?
- What are the settlement priorities and local experiences driving the sustainability of the lifecycles of housing and infrastructure in desert regions?

While the emphasised terminology above could be debated further, the essence of the research is to understand that the development of remote Aboriginal settlements is limited by insufficient local capacity, insufficient understanding of the local values and cultures around the local housing experience, and the many factors that impact on lifecycle costs beyond the normal experience of mainstream housing.

### Value proposition at project inception

The research project value proposition was initially framed to contribute to extending the lifecycle of desert housing and its support infrastructure through development of improved, sustainable policy, technacy-based educational strategies and software-based decision tools, informed by a greater understanding of the user experience.

This has been detailed in the original scoping project proposal as being:

- to establish the extent to which new understanding better informs the national Infrastructure Grants Commission processes for valuing and planning desert livelihoods
- to establish key knowledge for innovative interventions, implement retrofit and green-field development of technologies and support capacities in desert settlements
- to establish scope of knowledge needed to account for and respond to threshold factors that limit desert settlements from extending the lifecycles of conventional housing and infrastructure, and from receiving locally relevant or customised education and training.

Opportunities for innovative approaches will be identified.

## Conceptual framework

### Development of the conceptual framework

Focused stakeholder workshops<sup>7</sup> and discussions among members of the *Lifecycles* team in 2004 further developed the ‘whole-of-systems’<sup>8</sup> approach beyond the scope originally discussed. The Melbourne workshop with the Centre for Appropriate Technology (CAT) and the then Aboriginal and Torres Strait Islander Services Housing and Environment Branch (ATSIS-HEB) specifically identified the need to build on Seemann’s doctoral research into socio-technical systems (1997) as a starting point for this research. His central thesis is that technology choice and systems have a significant feedback effect on social organisation and settlement livelihood, and that housing and

<sup>7</sup> In Melbourne, April 2004, prior to the finalisation of the project framework; in Alice Springs, September 2004 and February 2004, soon after the commencement of the project.

<sup>8</sup> See the section on **Theoretical approaches**.

related hardware systems that match social systems tend to yield a more beneficial and sustainable outcome for both the human community and the functionality of the technologies that facilitate that community. The research pointed to the essential role of well-informed local management of technology choice, and access to tools, resources and processes as key variables for improved housing lifecycles. A review of Seemann's work began with determining the extent to which his thesis findings continue to be relevant, and assessing their potential to inform the articulation of the theoretical underpinnings of this project and contribute to the development of software models.

### *Review and analysis of prior socio-technical systems research*

#### **Sustainability of shelter systems**

Aboriginal desert settlements are the dominant focus of Seemann's thesis. Seemann asserts that the general sustainability of remote settlements is largely related to the quality and adaptability of local talent to engage with, and manage, the social and technology systems of settlement development, rather than the design or the quality of such technology systems alone. This includes evidence to the degree that house-users were able to personalise their dwelling by way of access to appropriate and affordable tools. According to Seemann, fostering and facilitating house-user engagement with their dwelling is a key factor in predicting house repair status: the more evidence of house-user engagement, the more likely the general state of house repair is improved. Seemann further proposes that new education standards, locally defined risk management strategies, and institutions delivering regional technology were fundamental for sustaining improvements to the material quality of life in remote settlements.

#### **Relevant findings**

In 2005, a series of visits to remote settlements were carried out by Lifecycles researchers, as well as meetings with a wide variety of stakeholders. The goal of these visits was to discuss the basis for a case-study trial project, as seen by key agencies, users and stakeholders associated with remote housing. Fieldwork consisting of settlement visits and interviews with settlement councils, settlement clerks and settlement housing officers was undertaken, and opinions about housing and infrastructure processes and outcomes were noted. It was concluded that little had changed from Seemann's findings in 2005, except for the speed of delivery of new housing stock.

When householders have a broad range of tools for repairing their houses, the houses get repaired. This association is well indicated by the level of repair and maintenance resources sold through the local settlement store for geographically discrete settlements. Other findings that appear to remain current include:

#### *Skills and talent development*

- General technical expertise and knowledge of the livelihood costs and benefits of different technology choices were substantially under-represented among settlement house users and managing councils (Figure 1).
- Where some settlements had technically qualified expertise, sustainability was enhanced by the diversity of skills rather than any one specialist skill category, and by a training emphasis on work organisation, problem-solving/'research' skills and cross-cultural communication rather than specific repairs and maintenance (or conventional, trade-oriented) skills alone.

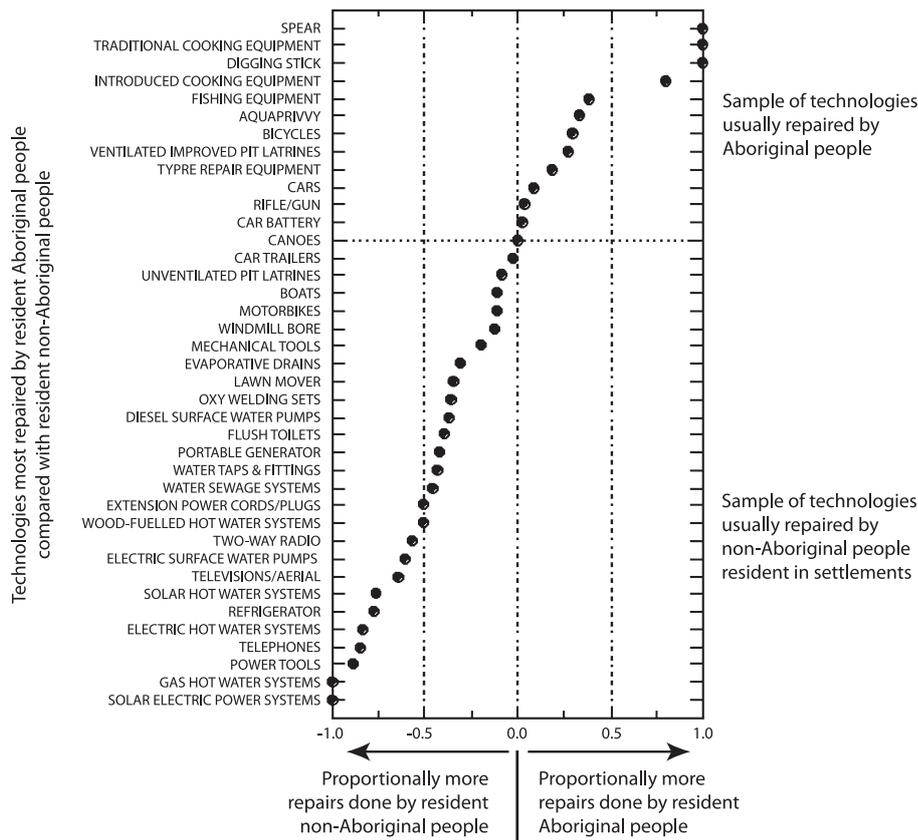


Figure 1: Technical function by degree of local Aboriginal participation  
 Source: Seemann 1997

- General technical skills were more effective than specialised technical skills in a cluster of settlements; the existence of specialist building trade skills in a settlement contributed a surprisingly small amount to improving the general repair conditions of houses.
- Local school curriculum tended to emphasise language literacy and numeracy, despite very little evidence of householder cues and reinforcing images for literacy and numeracy; for example, very few houses had books, posters or other text cues. In contrast, households contained rich, active examples of technacy and innovation cues and engagement; for example, efforts made, often with minimal tools, to repair, structurally support or construct house and around-the-house amenities. A serious question of curriculum relevance appears to be evident in many remote settlements. There appeared to be potential to develop literacy and numeracy through a base curriculum in technacy and innovation education themes. We note this same conclusion was reinforced in a number of recommendations by the Ramsey Report (December 2003), *Future Directions for Secondary Education in the Northern Territory*, including that:

*9. the NT Government, through the Minister, take up with the appropriate Ministerial Council the feasibility of a national testing regime for technacy to parallel testing for literacy and numeracy so that standards can be established for these skills; and that NT DEET [Northern Territory Department of Employment, Education and Training] undertake preliminary work in this area which may be presented at appropriate forums to bring the issue onto the national education agenda.*

(Northern Territory Government 2003, p. xxi)

### Opportunities for technical occupations

- Technical occupations were disadvantaged relative to teachers and health workers, who had the institutional support of schools and health clinics and worked with resident professional peers (e.g. nurses, doctors, teachers) to whom they could refer. The comparable peer support for technical occupations, essential for housing and infrastructure, lacked similar local, institutional presence.
- Health and education occupations were supported by local, dedicated government institutions/organisations with administrative centres in or near settlements and stable ongoing funding programs; that is, they worked under stable systems and so had stable resource flows. In contrast, industrial occupations were not operating in this context, and were very unstable. This was seen as a major retardant to sustaining and growing technology talent and associated livelihoods in settlements. This raises the question of whether, along with education and health, local technical institutional presence should be regarded as a social good investment in outback Australia.
- Larger settlements (or geographically close, networked settlements) sustained a greater amount of trained Aboriginal expertise (in occupations, generally) than smaller settlements.

### Funding and gender effect

- Government or private technical support/funding, where available, was usually supply-driven and divided among technical specialisation areas such as housing, power and water, and transport departments. This disaggregated service model appears to be ineffective in dispersed delivery contexts of housing in remote settlements.

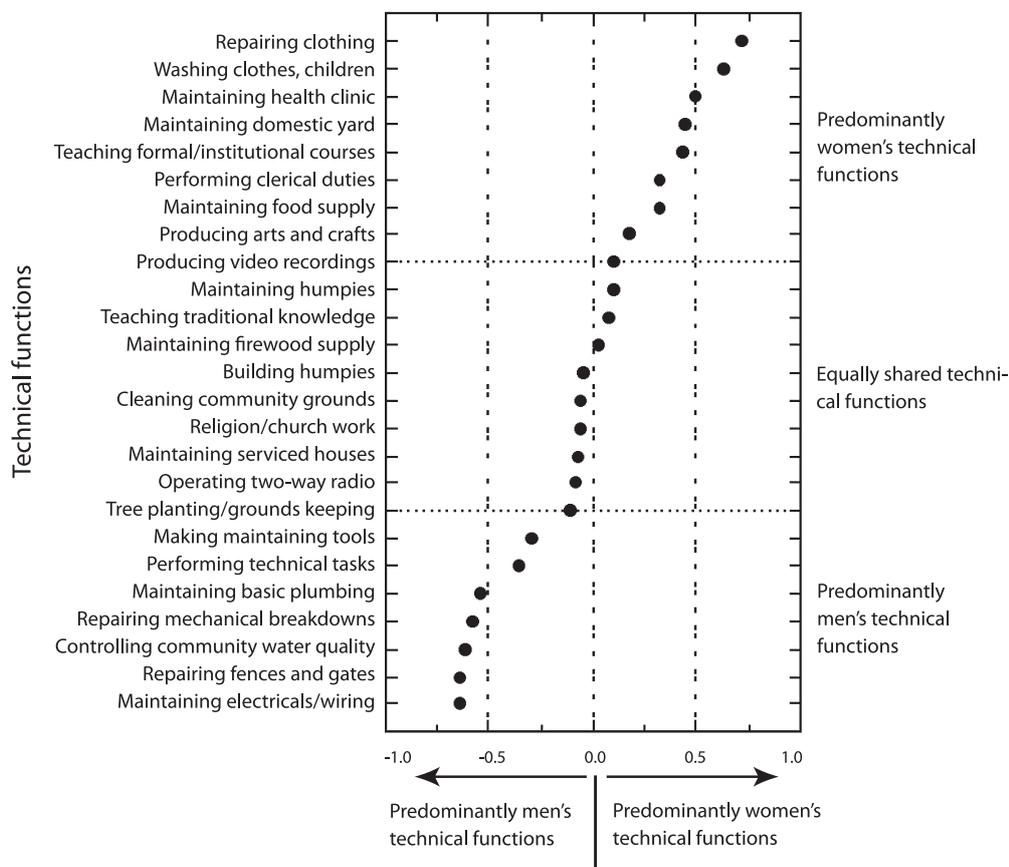


Figure 2: Gender by technical function

Source: Seemann 1997

- Funding for technical-based services was risky, project-based, stop-start and bidding-oriented from year to year and not locally based or institutionally supported.
- Funding cycles affected gender employment issues: men's work, seen mostly in the technical fields, was sporadic or opportunist; women's work, seen mostly in the educational and health fields, was steady, institutional, developmental and programmed (Figure 2).

### Housing and materials

- Two distinct shelter types prevailed within remote settlements (Figure 3):
  - Light weight/local resource/temporary (implying handy-person tools required to maintain)
  - Heavier/externally sourced/permanent (implying specialist tools/high level and longer training required, which may not be affordable).
- The temporary building materials in settlements generally did not require the use of many, specialised or powered tools to shape, position or transport them. In contrast, the cluster of permanent building materials implies a more sophisticated collection of tools and equipment to construct, repair or modify them. This may affect the degree of local participation in household repair and maintenance.

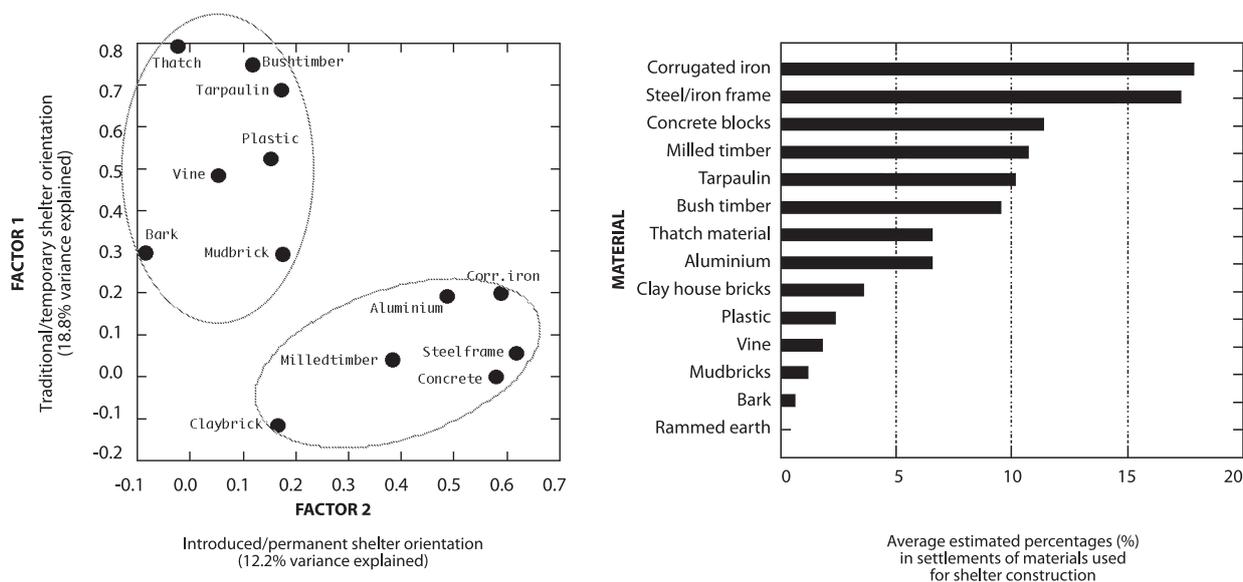


Figure 3: Pattern of housing materials found among remote, small settlements  
Source: Seemann 1997

### Socio-technical capacity to maintain housing

- Reasonable indicators of whether settlements were able to sustain serviced houses included skills of social organisation, completion of non-technical, vocational education qualifications, individual access to appropriate tools and a proportionally large number of semi-serviced transitional shelters (that were normally not maintained by councils).
- Most settlements could not sustain work opportunities for specialist trades.
- Semi-technical and non-industrial occupational skills, such as settlement health and primary school teacher assistant skills were the most effective in improving the general repair conditions of houses (Table 1). This can be partly explained by the increased emphasis that training for these occupations places on work organisation skills and cross-cultural communication skills, compared with the skills learned in specialist trade or industrial technology occupations. It was observed that more Aboriginal women than men participated in training that emphasised these organisation and communication skills. It was also

observed that funding for technical occupations and associated opportunities for on-the-job skills development was inconsistent and that this had more of a social effect on the skills development and educational participation rate for Aboriginal men than for Aboriginal women, particularly for small settlement populations.

Table 1: Trained occupations by impact on housing repair status

Trained in occupation	House repair (r) status	Variance explained	Probability (p)
Health	0.582	33.8%	0.001
Mechanical	0.424	17.9%	0.019
Education	0.420	17.6%	0.021
Plumbing	0.406	16.5%	0.026
Power station	0.402	16.2%	0.028
Clerk	0.402	16.2%	0.028
Groundsperson	0.300	9.0%	0.108
Church	0.280	7.8%	0.134
Electrical *	0.275	7.6%	0.141
Other	0.272	7.4%	0.146
Computer/Word	0.227	5.2%	0.227
Videowork	0.204	4.2%	0.279
Works leader	0.187	3.5%	0.322
Building *	0.174	3.0%	0.357

Education input to house repair status output explained by % variance and correlation (r)

Source: Seemann 1997

NB: \* Electrical and building occupations, where they existed in settlements, appeared to have minimal impact on housing repair status

- Aboriginal Australians tended to use a different set of multi-purpose tools and range of application of tools than trade-based agencies and occupations (Table 2).
- Most settlements rated the majority of their technologies as ‘useful’ rather than appropriate for their settlement situation. This result indicates that while functionally relevant or important to settlement activities, the technologies are generally difficult to maintain, often causing considerable trouble during efforts to arrange their repair (Figure 4).

Table 2: Tools and hardware most used by house-user versus council housing repair depot

Note: Seemann 1997

Occurrence of tools/hardware among house-users	%	Occurrence of tools/hardware in council depot	%
Axe/tomahawk	78.8	Shifting spanner	84.8
Spear	75.8	Screwdriver	81.8
Broom	72.7	Hacksaw	81.8
Garbage bin	69.7	Socket set	81.8
Digging stick	63.6	Tyre repair tools	81.8
Television	60.6	Oxy welding set	81.8
Fishing tackle	54.5	Hammer	78.8
Rifle/gun	54.5	Pliers	78.8
Utility knife	45.5	Shovel	78.8
44-Gallon drum	45.5	Crowbar	78.8
Electric extension cord	42.4	Spanner set	78.8
Shovel	39.4	Measuring tape	78.8
Hammer	33.3	Tyre bead breaker	78.8
Screwdriver	33.3	Arc welding set	78.8
Shifting spanner	33.3	Vice grips	75.8
Video recorder/camera	30.3	Stilsons wrench	75.8
Pliers	27.3	Woodsaw	69.7
Wood rasp	27.3	Cold chisel	69.7
Boat	24.2	Nails, screws, glues etc.	69.7
Metal file	21.2	Electric extension cord	69.7

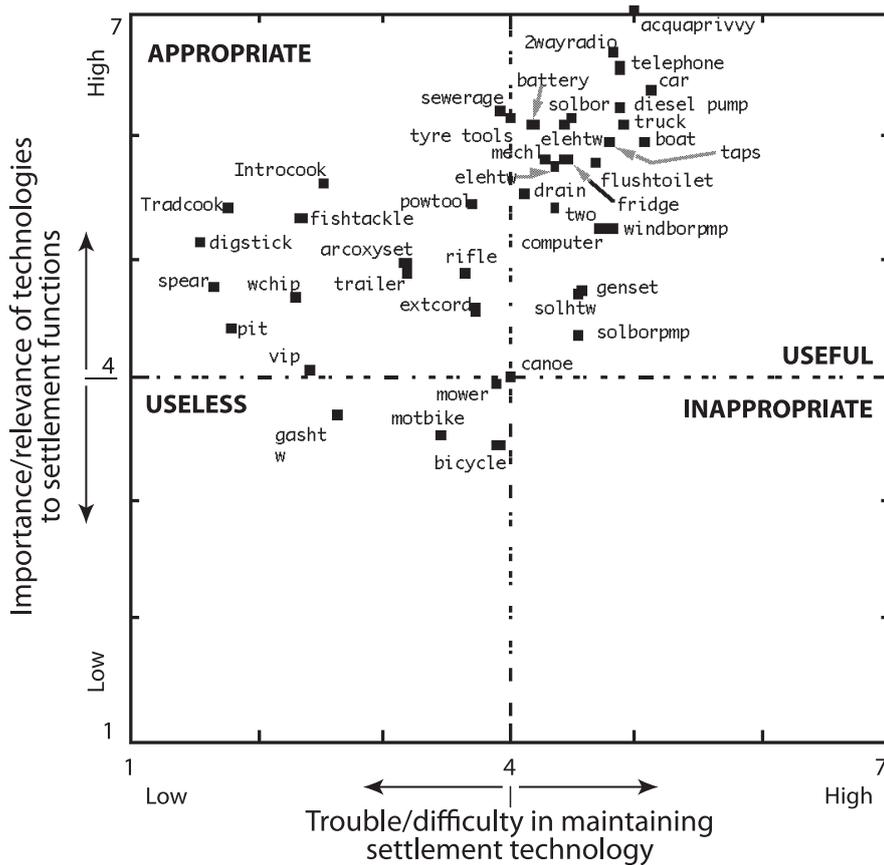


Figure 4: Repair and importance ratings of hardware in remote Aboriginal settlements

Source: Seemann 1997

Note: In arid to tropical locations

- Technology breakdown was attributed more frequently to social than technical factors. The top three factors were a mix of social and technical factors, suggesting that the operating environment of many technologies in settlements was socially complex and environmentally harsh.
- The more tools that individuals possessed, the better the repair status of their houses.
- Training in conventional technical trades was unable to keep houses in a good state of repair, particularly when more people moved from transition shelters to fully serviced houses. A low threshold appeared to exist for the number of serviced houses that most settlements could sustain to a functional level of repair. Recent literature (Young, Guenther & Boyle 2006) suggests Seemann’s findings remain essentially unchanged, noting that Vocational Education and Training for settlements is more effective if a person:
  - lives in a ‘town’ or large settlement close to town
  - speaks English as their first language
  - is prepared to move away from home for training and work

Young et al. conclude that current VET programs struggle to maintain curriculum relevance in outback settlements, stating that:

- emerging livelihood activities in settlements will not reflect mainstream industry occupations
- capacity building and settlement development are critical but not currently core business of VET.

The combined findings of Seemann (1997), Young et al. (2006) and others, spanning nine years, suggests that a serious consequence of policy history for many remote Aboriginal settlements is that technical knowledge, expertise support and curriculum relevance favours a talent-drain in housing and related technologies from the desert to the centres.

## Technacy education and the Lifecycles Project

Through field research and the examination of Seemann's thesis findings, especially those concerning technacy<sup>9</sup>, this research identified the need to address in any future pilot study technological problem-solving (e.g. project management, socio-technical diagnosis and communication capabilities) as a contributor to emerging capacity development – particularly the development of generic understanding and skills in creativity and innovation for working through technological ideas and projects.

Activity was therefore prioritised to assist and explore, over the long term, the development of critical capacities in choosing, valuing, problem solving, and skilfully applying technology to meet human needs.

The research has found a major capacity gap in most isolated, small desert settlement schooling at two levels. At the first level, most educational services stop for most desert children in the Northern Territory after around 11 to 12 years of age, not to be re-engaged until early vocational education is considered around 16 years of age (Young et al. 2006). By this time there is a very small likelihood of uptake and completion of further education. Secondly, the time spent at primary school in many cases barely dedicates time to fostering technacy capacities, let alone locally relevant and engaging learning. The seriousness of this gap, in both engagement and in content, affects a settlement's capacity to manage, choose and to engage in a contemporary, material culture and economy in their region.

The Northern Territory Government (2003) has, to its credit, recently noted the need for such capacity development:

*As part of the Futures Portfolio, the levels of literacy, numeracy and technacy [an individual] has reached should be clearly stated ... Eventually, we would hope that no young person will leave school without at least Year 9 literacy, numeracy and technacy levels....young people who leave school with gaps in literacy, numeracy and technacy might prevent them from meaningful participation in society.*

## Contribution to Lifecycles Conceptual Framework

The overall implications of this thesis is that modes and assumptions underpinning key intervention areas such as education and service standards are part of the problem inhibiting real, sustainable and flexible solutions and best practice policies relevant to the desert settlement context of Australia.

The main outcome of this research is that separately conceived technical and economic considerations are inadequate for developing innovative responses to need. A key concern of the project is how social, end-user experiences can enhance the decisions to extend the life of housing so as to also enhance local livelihoods.

The key points from Seemann's thesis appear to still apply and have the potential to significantly influence housing and technical services policy and settlement education policy. In addition, they provide substantial insights into changes needed in the role and structure of government extension

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<sup>9</sup> The ability for people to think and work creatively in the field of technology is known as technacy (Seemann & Talbot 1995).

and education services associated with infrastructure programs in desert settlements, particularly in relation to understanding the systems requirements to deliver more appropriate and cost-effective technical services, education and housing technologies.

## Theoretical approaches

### Introduction

Four theoretical approaches have been adopted in this research as a conceptual framework for understanding settlement sustainability and for re-orienting thinking away from the conveyor-belt model to a holistic lifecycle approach. These are:

- The Total Capital Model
- Socio-Technical Systems
- Ekistic Theory
- Technacy Theory.

### Total Capital Model

Sustainable development of a remote settlement involves gaining maximum benefit from the investment made in the region's total capital. Total capital is deemed to include:

- **Physical capital:** built capital (e.g. buildings, infrastructure); natural capital (e.g. air, water, land, biodiversity) in relatively undisturbed ecosystems and modified ecosystems (e.g. agriculture, aquaculture)
- **Social and economic capital:** human capital (e.g. knowledge, skills, capabilities, education, health); social capital (community and institutional networks and interactions); cultural capital (e.g. kinship, language, ceremonies, stories); financial and economic/human productivity capital (e.g. macroeconomic, microeconomic, governance, local and informal economies and exchanges).

The primary focus of this project is built capital (housing and infrastructure) and how it articulates with social and economic capital.

The concept of total capital has emerged from many directions as the ideas of sustainable development have been articulated and tested over the last 20 years. Economist Paul Ekins was arguably the first to articulate 'capital' as other than the purely financial, linking ecological capital to financial capital systems (Ekins 1992). Total capital extends Ekins' ideas by bringing together diverse thinking intended to temper the primacy of financial/economic capital in determining processes of development and to identify value other than in direct financial terms. One key driver was to consider the benefits obtained from natural resources and ecosystems as a form of capital, which could be stored or spent accordingly. This idea was fully articulated in the early to mid-1990s as natural capitalism and the triple-bottom-line thinking which emerged in the corporate sphere in North America and Europe, as popularised by Paul Hawken (1993) in *The Ecology of Commerce*, John Elkington (1998) in *Cannibals with Forks: The Triple Bottom Line of 21st Century Business* and, later, Amory and L. Hunter Lovins in *Natural Capitalism: Creating the Next Industrial Revolution* (Hawken, Lovins & Lovins 1999).

Another driver which emerged as a counterpoint to financial capital was social capital; Robert Putnam, among others, was one of the first to express it in the late 1980s and early 1990s; more recently, after the publication of Putnam's *Bowling Alone: The Collapse and Revival of American*

*Community* (2000), the ideas of social capital informed a variety of fields, from community development to settlement planning (such as the New Urbanist movement, where the older physical forms of American townscapes were re-created to try to facilitate the building of social capital).

The *Total Capital* approach is useful for mapping all the factors that contribute to settlement sustainability, and their interrelationship, but the main focus is on what system theorists identify as ‘stocks’. The model has more value when expressed in terms of systems dynamics.

Stocks are related to the various capitals held by settlements until needed to meet settlement functions and aspirations. Stocks can be undesirable: waste and pollution can also be stocks retained by settlements. Stocks are related to flows, by having not only something which can flow, but something which can help regulate flow and help settlements be more resilient to the effects of shocks. The Total Capital model does not identify how capital stocks contribute to flow and to the dynamics of settlements. Capital-related dynamics are best explained in terms of systems thinking.

### Socio-Technical Systems theory

Systems thinking is concerned with not just capital stocks, but with how the capitals work together, and how outcomes are generated, whether desired or unanticipated. It analyses how different factors drive processes, what the inputs are, what the outputs are, and how processes are modified by feedback, in a continually moving process, often with (sometimes competing) goals as broad drivers. There is a large body of work, developed over the last 60 years, explaining systems and systems thinking, and this project draws on that experience. Systems thinking arose from the confluence of work in understanding ecological systems, organisations, human societies and innovation processes (Berkes & Folke 1998; Doxiadis 1968; Emery 1971; Gunderson & Holling 2002; Rogers, 2003; Skyttner 1996). Even as far back as the nineteenth century, Hegel (cited in Skyttner 1996, p. 30) gave us a clear path to a systems understanding by positing that: ‘the whole is more than the sum of the parts’.

Skyttner (1996 p. 20) describes the understanding of systems thinking in the following terms:

*Understanding must therefore progress from the whole to its parts – a **synthesis**.*

*Synthesis takes the steps of analytical science in reverse order.*

- *Identify the system of which the unit in focus is a part.*
- *Explain the properties or behaviour of the system.*
- *Finally, explain the properties or behaviour of the unit in focus as a part or function of the system.*

Systems thinking can be applied in the understanding of natural systems, technological systems and social systems. The domain of systems thinking where people and their technological systems intersect is called ‘socio-technical systems’, developed in the early 1960s by Emery and Trist (Emery & Trist 1960; Emery 1971). (Note that this does not imply that the impact of natural systems is not important in the dynamics of physical settlements; this was also considered in the research.)

The static models of understanding how societies and settlements work developed into a systems approach over the 1950s–1970s, as more writers and researchers were making connections between activities and issues that generally had not been considered as greatly connected. In attempting to understand the sustainability of human settlements, many of the systems ideas were applied in new ways. Early models of sustainable development, such as the Extended Metabolism Model of sustainable settlements (Newman 1999; Newman et Al. 1996; Newman & Kenworthy 1999), connected the capitals as resources available to flow through settlements.

In parallel, in the late 1990s, the linking of the capitals to settlement outcomes was articulated through the Sustainable Livelihoods Framework, which emerged through the UK Department for International Development (DFID). The Sustainable Livelihoods approach incorporates natural, physical, financial, social, human and (later) political capital as part of a systems view with a focus on livelihood rather than settlement livability (Farrington et al. 1999; Scoones 1998; Sustainable Livelihoods Guidance Sheets n.d.). Socio-technical systems theory is explained further under Theoretical Synthesis in the Conceptual Framework.

## Ekistic theory

Architect and urban planner Constantinos Doxiadis developed ekistic theory, or the science of human settlements, in the 1950s and 1960s (Doxiadis 1968, 1970). Walker (1976) proposed that, commonly, ekistics is a framework for research into human settlements and their particular problems; ekistic thinking, then, has had a widespread influence in planning and regional development, and continues to guide thinking about discrete settlement establishment and regional development. Major settlement planning projects using ekistic theory are under way in many parts of the world.

A fundamental ekistic concept is that human settlements are metabolic, and have a tendency to proceed to either ‘death’ or transformation (Seemann 1997). In anticipation of the issues concerning this Lifecycles research, Doxiadis (1968, p. 219) wrote that:

*Unlike plants and animals, human settlements have no predetermined life. Their elements, however, may have a predetermined life. A house has a certain lifespan which can be prolonged or shortened depending on its maintenance, as is the case with plants and animals; but this cannot go beyond certain limits unless maintenance is interpreted to mean a gradual replacement of all its parts, in which case it can theoretically live forever ... as long as it is considered useful for them to be maintained.*

Doxiadis (1968) proposed that human settlements establish, develop and either decline or transform. Internal adaptation to change driven by external factors is critical in facilitating sustainability outcomes. Responses to external factors are strongly connected to settlement goals, expressed by the settlement’s inhabitants, and are largely subjective. Doxiadis (1968 p. 6) proposes that a principle and common goal for settlement development is a sense of happiness, security and safety. How this applies to desert settlements is implied in the research through the proposal of a systems approach where livelihood and liveability are outcomes.

Ekistics focuses on patterns of settlement via a classificatory framework incorporating the dimensions of scale and elements common to all human settlements. Scale ranges from the individual in their living space, to the city, the region, and the world. Elements common to human settlements include: Nature, Shells<sup>10</sup> and Networks (broadly associated with Physical capital); and Society and Individuals (broadly associated with Social and Economic capital).

Ekistic theory also describes the drivers that initially establish a settlement or group of settlements as their fundamental goals. It describes ‘functions’ or capital transforming processes occurring within settlements. Settlement functions are activities such as installing energy systems. Some functions support other functions – training in fixing taps supports housing maintenance. In this manner, it is possible to understand a particular dynamic such as house maintenance within a single settlement or common to a range of human settlements.

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<sup>10</sup> ‘Shells’ in Settlement Science means the locations of human functions/activities and are observed as having boundaries. Shells include houses, shelters, and structures, but also the spatial boundaries of hunting areas, ceremony areas, and sports areas. Shells are linked via networks such as pathways, roads, and communications which represent the paths along which resources and people flow to reach shells (places of activity).

In emphasising the importance of understanding settlement functions, Seemann (1997) proposed:

*... that settlement functions are the primary point or locus where settlement metabolism occurs. This characteristic makes them important starting points for most research methodologies concerning settlement development. Settlement functions also:*

- *represent the interface between inputs and human amenity and so may be considered as sub-systems within the overall system of the settlement*
- *contain the essential components of human and physical resource organisation, and*
- *are organisational systems with social and technical components that are influenced by their overall settlement context and goals*

Thus, Seemann made a strong case in his earlier research for using ekistic theory as a contributing framework for viewing settlement function, dynamics and, in the long view, sustainability. The review of Seemann's thesis reinforced the value of ekistic theory to inform the design of this research.

## Technacy theory

There is a dearth of theoretical or conceptual underpinning to guide the development of human material and digital capability, and, by implication, human settlement. If current technological practice can be termed anything, then 'pragmatic' best describes it; it is also very mechanistic and deterministic: that is, there is a lay view that technology pursues the most efficient path to a desired outcome. Unintended consequences of such an approach are myriad and include environmental degradation, loss of community, and climate change. In terms of technological development in capital based economies over the last few hundred years, it has served us (mainly Western democracies) very well. Only in recent years, when resource limits and population growth have coincided with the ecology of our lives, and human society has become more complex, have the limits to the pragmatic approach been apparent.

The significant need for all Australians to learn and develop a structured, yet rounded knowledge and skill base in technology and innovation was first raised by the Australian Government in its 1996 'Foresight Report', *Matching Science and Technology to Future Needs: 2010* (cited in Australian Science Technology and Engineering Council 1996). The government concluded:

*For many years, literacy and numeracy have been the cornerstones of western industrialised education. Yet many people have questioned its adequacy for a more technological age that requires new skills in technology and problem solving. ASTEC proposes the framework for considering this is 'technacy'. Technacy is a way of defining the meaning of 'technological literacy' that goes beyond competency in using technology. It refers to a holistic view of technology problem solving, communication and practice that includes consideration of social, ethical, technical and environmental resources and constraints.*

In terms of desert settlements, if there has been a theoretical underpinning, then it could be described as being based in social equity. This has sometimes resulted in the driver of social equity (in setting social policy) conflicting strongly with the driver of pragmatism (in best practice delivery of housing and infrastructure), which leads to unacceptable outcomes. In effect, there has been no framework to guide the technological development often seen as the means to deliver social equity-based outcomes. By extension, the current debate about Aboriginal affairs, which is moving from a rights-and-entitlements basis to a livelihoods basis, still fails to inform its position with some reasonable link to an underlying theory of technology and technological development.

Thus the concept of technacy (Seemann 1997, 2000, 2001; Seemann & Talbot 1995) was incorporated as a key aspect of the research framework.

The development of technacy as a theory was informed by the earlier work of authors such as E. F. Schumacher (1973), Ian Smillie (cited in Seemann 1997) and Kelvin Willoughby (1990). Smillie identified that all technology genres display a few common interdependent components:

- a social or agency component (inclusive of organisation, people [i.e. users, producers, audience and administrators of technology], and required knowledge, skill and culture)
- a technical-tool system component (inclusive of instruments, devices and mechanisms [digital and industrial] such as computers, jets, tools, machines, software and management systems)
- a material (or transformable resource) component (inclusive of primary and secondary resources, energy, consumables, data, information, processed materials and any resource being transformed by the said tool component above)
- a purpose and broad context constraint component (inclusive of time-series effects, economy, eco-systems and historical information that influences and drives technical activity).

While technacy (formalised in the Australian lexicon by the Macquarie Dictionary since 1991) is described as a theoretical underpinning of the Lifecycles Scoping Project, it is one that emerged from an understanding of the theoretical perspectives of Schumacher, Smillie and Willoughby combined with the experience of technological activity in remote desert settlements. Aboriginal people, particularly from the remote western desert regions of Australia, were instrumental in its conception; it is strongly pragmatic, but the pragmatics are anchored in a holistic rather than a reductionist approach. Technacy is an evolving framework, conceived and developed to:

- facilitate greater understanding of technology as a value-laden social process
- link the technological, social and environmental aspects of human activity
- develop problem solvers (or technate individuals) who can choose, evaluate, transform, communicate and apply technologies that are appropriate for local contexts.

As described by Seemann (2001 p. 2):

*In the same way as literacy is core to language and comprehension in society, or numeracy to number and mathematics, so too is the discourse in technacy to technology in society. Technacy is therefore not driven by vocational themes or agendas. Instead, its themes are driven by developmental concerns that underpin all other discourse that may follow in related branches of study and vocations.*

In practice, technacy education for desert people became available through the Aboriginal Technical Worker (ATWORK) program, and was delivered by the training division of the Centre for Appropriate Technology, Alice Springs. This nationally accredited vocational program achieved national recognition in the Vocational Education and Training (VET) sector, with a qualification in *Applied Design and Technology*. One of its goals was to, in time, foster the development of technology managers in Aboriginal settlements in addition to technical skills relevant to remote desert conditions. The ATWORK program is different from conventional technical training because of its emphasis on technate action pursuing appropriate solutions as an outcome, rather than just technical skills (Talbot & Kroker 1998).

## Theoretical synthesis in the conceptual framework

### A systems approach

The Lifecycles Project applied a systems approach: to conceptualise its data collection, to propose key strategies, and to manage the many elements and activities of the research through a coherent framework (Seemann 2003). The framework integrates and expresses the theoretical approaches described previously:

- incorporating systems thinking
- linking the capitals
- viewing remote settlements as systems (consisting of nature, society, shells, networks and culture)
- sustaining people on country through a technate interaction with technology.

The systems diagram below (Figure 5) summarises the systems framework for research; it also reflects the dynamics of settlements. It assumes that a more effective flow and use of all capital and capability will ultimately be directed towards its contribution to sustainable desert livelihoods and improved liveability in remote settlements. The units of the system diagram are explained in the following sections.

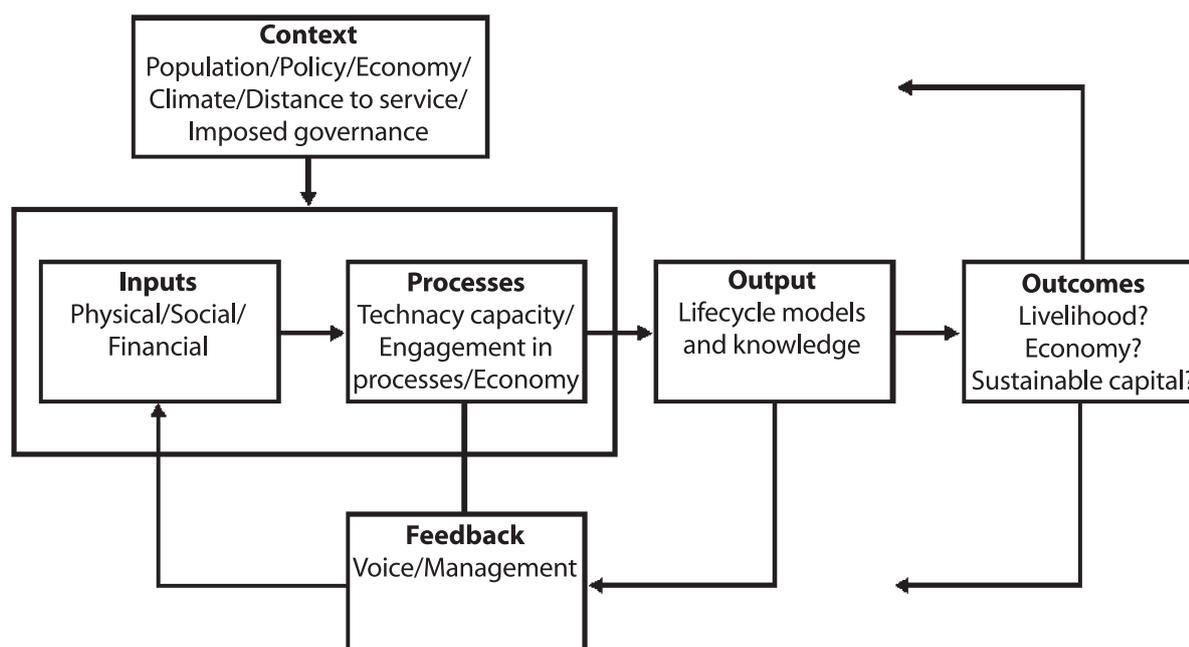


Figure 5: Conceptualisation of the Lifecycles Project

Note: Improved understanding leading to extended lifecycles, with resulting livelihood and liveability outcomes

### Contexts

The context box describes the natural and human drivers of settlement development and sustainability. External social drivers such as government policies, economic conditions, imposed governance systems and the goodwill (or otherwise) of the broader Australian community combine with physical drivers, such as climatic conditions, environmental limits, distance to centres of population and availability of resources, to either obstruct or foster sustainable development. It is typical in the remote settlement experience that these external drivers not only conflict with settlement goals, but also with other drivers, making it difficult for those at the local level to develop a coherent understanding of the big picture. People at the local level have a long-developed

understanding of life on country, and much of this knowledge is context specific and does not readily extend to understanding these external driving forces shaping their settlements. Walker (2001) summarises the context-specific nature of knowledge: ‘A lot of what we know is only valuable where we live; it often does not have universal portability’.

This point of view applies equally when looking outwards from settlements to the representatives of political, governance and economic systems who design the external responses driving settlement change.

### *Inputs*

In the framework, *inputs* refers to the flows of resources, or capitals – money, energy, materials, food, education, services, skills – into the settlement. It also includes resources (or stocks) – Aboriginal knowledge, existing built and manufactured assets, and ecological assets (scenery or valuable eco-systems) – existing in the settlement which can be introduced into the flow of resources. Inputs can be supply driven or demand driven, pushed or pulled into settlements.

### *Processes*

The term *processes* refers to the application and usage of resources with an output in mind. It can be assumed that such resource use is at the service of settlement goals, but resource use can be planned or unplanned, controlled or uncontrolled, conscious or unconscious. The types of processes and their impact can be determined by the external drivers in combination with the settlement’s internal capacities, such as levels of technacy, internal organisation, cultural patterns of communication, and traditional law.

Resources can flow through settlement processes in a wasteful way, whereby settlement goals cannot be achieved, or worse, a new set of problems are created such as pollution caused by misuse of material flows, disruptive living patterns caused by inappropriate house design or welfare dependency. Resource flows also indicate any mismatch between the nature of inputs and settlement capacity. To manage resource flows through dynamic community processes is a principal challenge for sustainable desert settlements.

### *Output*

The diagram identifies *output* as the desired amenity or waste of various settlement functions such as houses or trained people. However, these are seen as logically driven by higher-order goals which are described as the driving outcomes sought: in this case, livelihood value. The development of a prototype Lifecycles software model is another output of the framework.

### *Feedback*

In a systems sense, feedback is:

*...a basic strategy which allows for a system to compensate for unexpected disturbances... and is often defined as the ‘transmission of a signal from a later to an earlier stage’. Information concerning the result of own actions is thus delivered as part of information for continuous action. As a control mechanism it acts on the basis of its actual rather than expected performance...System conduct may however become very complex if several feedback elements are interconnected: the resulting dynamics will be difficult to calculate.*

(Skyttner 1996, p. 49)

Lack of meaningful feedback (or settlement-informed controls over inputs such as resources and educational curriculum, and over internal governance processes) has been a defining characteristic in the development of some remote settlements. It has arisen from a mechanistic approach to development, partly driven by paternalism, partly by best practice efficiencies (where local realities are ignored) and partly by lack of developmental competence by outside agencies. The Lifecycles framework, and the output of useful tools, incorporated feedback as an essential component of understanding the settlement-as-system, and of developing useful tools for contributing to settlement-as-system outcomes.

### *Outcomes*

Outcomes are what actually result from dynamic settlement processes, whether desired or unintended. Human socio-technical systems do not always behave according to the assumptions around the inputs and the settlement goals. Models of sustainable settlements identify that liveability and waste, in varying degrees, are the outputs of dynamic settlements (Newman & Kenworthy 1999). Liveability includes all those desirable aspects of economic and cultural development, in a functioning and healthy physical environment, where settlement members pursue their livelihood and their self-derived sense of a 'good life' into the long-term future. The challenge is to achieve more liveability from the available resources, and less waste.

## Part 2: Lifecycle model development

### Background and context

Early in this research, one outcome stakeholders expressed – particularly government stakeholders – was to develop innovative computer-based tools for understanding housing lifecycles so they could better allocate funds and resources at both the state/territory and settlement housing organisation levels. The Lifecycles Scoping Project incorporated research into the development of such models into the project proposal; the CSIRO Division of Manufacturing and Infrastructure Technology provided this expertise.

In this scoping stage of the project, CSIRO-based Lifecycles team members reviewed current knowledge of housing lifecycle models for knowledge gaps, using available housing data gained from CSIRO experience in developing lifecycle models for use in public housing in Queensland. This experience included public housing for Aboriginal people. This was combined with the data obtained by government and settlement agencies and informed by the remote settlement experience of the Southern Cross University Lifecycles researchers, to facilitate the development of prototype computer software to support innovative intervention strategies. This study focused on the remote desert areas of Australia. Figures 6 and 7 below show firstly remote Australia as defined by the ARIA measure and then Arid Australia as defined by the Bureau of Meteorology.

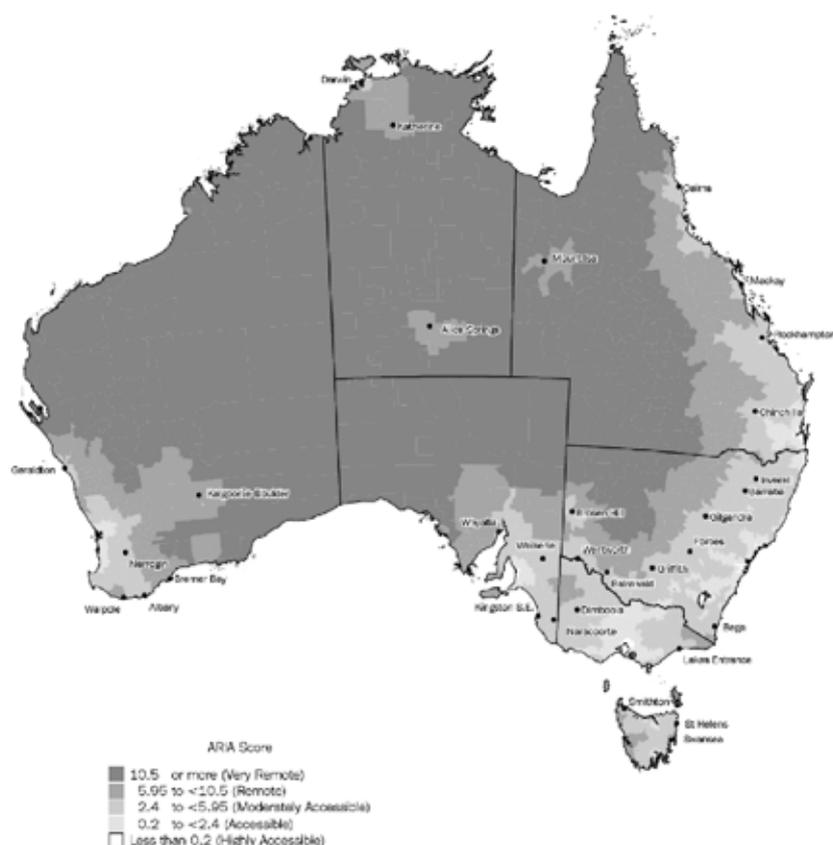


Figure 6: Remoteness map of Australia

Source: Taylor et al. 2006

By definition, the focus of the project is the intersection of these two maps; however, the findings and outcomes could equally be applied in other zones.

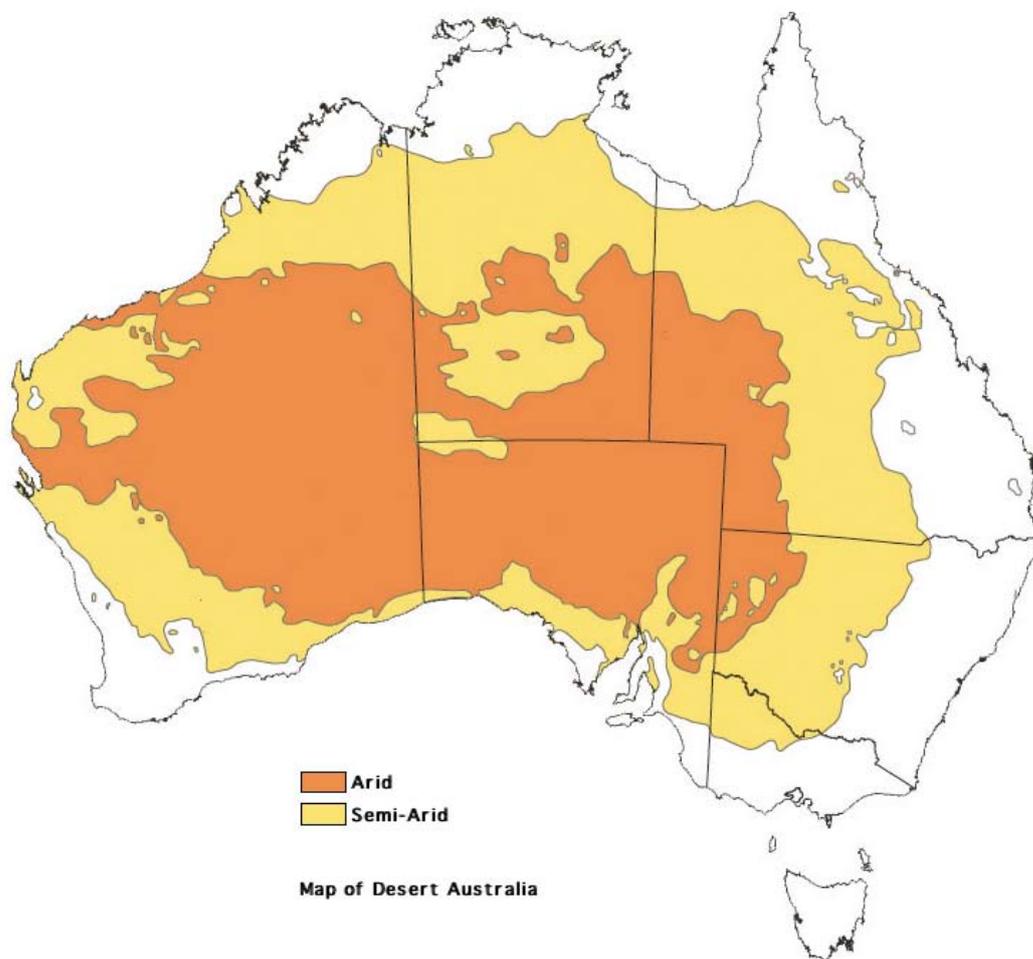


Figure 7: Aridity map of Australia  
Source: Australian Bureau of Meteorology

## Lifecycle model development methodology

### Desktop review

#### *Introduction*

The project plan called for a desktop review of existing models and housing data. The objective of the review was to understand the combination of relevant factors and how these factors can be valued, in order to predict the potential for housing and infrastructure to be extended over a number of years.

In terms of the hypothesis to be tested, the question considered during the modelling stage was:

*Can the properties in remote settlements be better managed in terms of maintenance to extent of the properties life and what impact will this have on maintenance expenditure?*

The question was explored considering the total cost of the properties as part of a Total Capital approach.

## *Prior knowledge*

Analysis of housing data carried out by CSIRO in Queensland prior to this project has helped to frame this component of the research. The analysis identified a number of significant factors in maintenance costs, including age, property type, and location. Remote locations achieved disappointing results by comparison to the metropolitan stock.

Location is a latent (or surrogate) variable that was not investigated in prior research. It is not clear from current modelling if the poor performance may be, in addition to remoteness, a result of the environment, management practice, use pressures, hardware/skill availability and so on.

Thus boundaries had to be identified to determine which factors (such as funding, resources, standards, definitions and indicators of remoteness) are included and which are excluded so we could understand the current state of play and why houses are performing poorly.

## **Document review**

A review of the literature regarding Aboriginal housing standards and lifecycle models was carried out during the initial phases of the desktop review. Stakeholders provided a number of reference sites to source other documentation that may be of use. Many documents offered valuable policy information and background/setting information but were of little value for model development. The document review focused on the following:

- reviewing asset management theory
- obtaining data in appropriate forms for use in model development
- reviewing the international experience with the development of Lifecycle models
- reviewing Australian experience with the development of Lifecycle models.

## Identifying data

The importance of having good data was stressed very early in the process. The use of both condition data and maintenance data has potential to allow calculation and verification of lifecycle horizons for components. Federal, state and settlement agencies provided several data sources for assessment and use in shaping software tools. This is discussed in more detail under **Housing Data**.

## Model development

### Model objectives

The process of developing of the software model was guided by the following objectives:

- to develop an objective assessment tool to measure the performance of asset portfolios
- to provide meaningful information at the appropriate scale
- to seek data quality – completeness, accuracy, consistency
- to provide information to enable informed decision making:
  - informed strategic planning – portfolio management, ensuring the right mix of properties
  - informed tactical program – asset management, ensuring the properties in the portfolio meet the requirements of the owners and tenants

- informed maintenance scheduling – property management, ensuring the properties achieve maximum value for the managers, maintenance program carried out to support the guidelines articulated in the Commonwealth–State Housing Agreement 2003–2008 (FaCSIA 2003) including:
  - targeting resources to most critical areas
  - identifying hot spots (either by component or location)
  - developing alternative strategies to be considered on a component-by-component basis
  - producing grant applications
  - separating various cost areas
  - developing benchmarks for various activities
  - reporting on Key Performance Indicators
  - reporting on other metrics as developed
  - enabling the various stakeholders to obtain information.

The pursuit of a useful tool is perceived by many stakeholders to be of benefit and is thus a substantial part of this project’s value proposition. The availability of a lifecycle tool will provide governments and settlements with more information to manage valuable settlement assets, and they could serve as a useful predictive tool in the strategic planning process.

## Review of Asset Management theory

Asset Management strategies should address both maintenance planning and prioritisation (Shen 1999; Johnson & Wyatt 1999) to allow a valid estimation of the future expenditure required (planning) and where this expenditure should occur (prioritisation). This should also include the option to provide different levels of service or permit long-term decisions to be made for different management options. It should not prescribe one particular strategy as being the best; instead, it should support the user to account for the specific operational environment within a systematic process in order to reach the most beneficial decision. Ideally, the planning/prioritisation process should evolve as the user learns about the problem and potential improvements, or as a reaction to changes in the operational environment.

Asset management planning models need to be developed to allow the prediction of maintenance expenditure, based on a risk-based methodology. This will allow prediction of the future performance of the housing stock, under different management and operational scenarios, and by inference, the whole-of-life costs associated with managing its building components under these scenarios.

When identifying and assessing which approach to adopt in managing housing stock, a major factor to consider is whether a proactive or reactive approach is to be taken, for example, whether the components will be left to operate to failure, or whether a dwelling’s building components will be replaced or proactively maintained before an unacceptable failure occurs, and in the later case whether condition monitoring or active protection techniques will be introduced to mitigate risk.

A critical component of any housing asset management model is that it should be adaptable to any management or operational strategy and be able to predict the necessary expenditure to maintain that strategy, including the long-term implications of that strategy on whole-of-life costs, system

performance, and customer service levels. This is of particular importance in the current climate of change where the system of providing housing and infrastructure into remote settlements is under review.

### Strategic approaches

Figure 8 shows one possible approach that could be applied to building components, where the components are classified as proactive or reactive building components, whereby different practices are applied to these component classes.

Under the strategy illustrated in Figure 8, reactive building components with low consequence of failure would generally be left to operate until failure, and then a decision would be made to replace/repair these building components. This decision would include considering the economics of continuing to operate the component past failure and its potential effect on other building components, including externalities such as the social impacts of ongoing failures (e.g. disruption to the settlement associated with maintenance). Generally, the condition of these building components can be predicted using statistical methods because significant quantities of failure data are available. McFallan and Tucker (2002) use statistical methodology to derive component failure models using condition data: the methodology is currently used by managers to plan maintenance programs and forecast future maintenance needs.

As the consequences of failure increase, building components (such as larger structural components) can no longer be operated to failure and they become proactive, which means that failure prevention measures need to be undertaken provided they are economically justifiable. In these cases, the probability of failure may not be well known and physical/probabilistic models need to be used, in conjunction with active condition monitoring, to determine the risk exposure and, therefore, the justification for using active failure prevention to reduce or maintain the risk exposure.

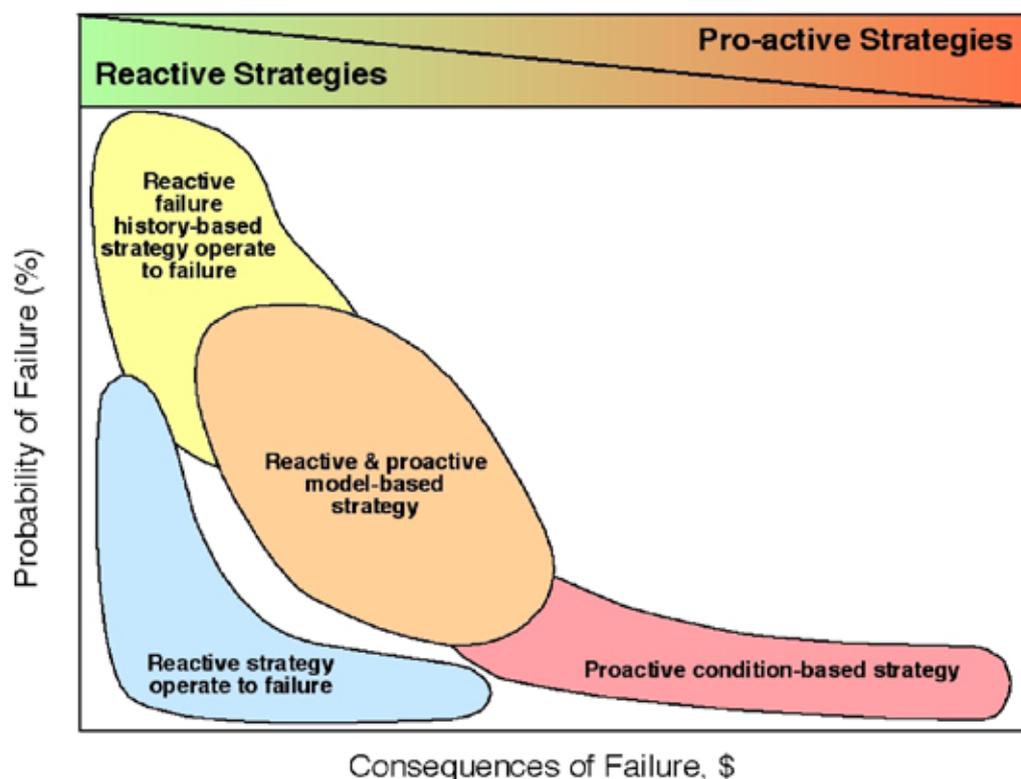


Figure 8: Asset management strategies for building components with different failure probabilities  
 Source: Burn et al. 2004

This approach would see the building components divided into reactively and proactively managed building components.

Reactive management will tend to apply to those building components with low consequences of failure, and these components will be generally operated to failure. For these building components, the risk is allowed to be realised as failure. This failure history can be used to project future failure frequency and therefore future risk. These building components comprise the majority of components in housing and cost the most to maintain and replace. Because of this high cost, planning models are essential to allow the prediction of the future costs associated with different management and operational strategies.

Planning models should allow housing authorities to model long-term operational strategies and provide them with the ability to see how their actions will impact on the performance of their housing stock and budgets, and provide the information needed for long-term strategic planning. Following the allocation of budgets, housing authorities need prioritisation strategies to allocate their budgets for replacing/repairing building components with the greatest need. It is proposed that a risk-based strategy that provides a systematic and flexible approach to prioritising housing component renewal would be the most suitable approach. This approach should allow the user to account for the specific operational environments using a systematic process to reach the most beneficial decision. It also allows for systematic processes to be specifically designed for a particular housing authority.

For building components justifying proactive management, a different approach is needed in which renewal, maintenance, operational, and condition monitoring strategies are required. In order to obtain a sufficiently cost-efficient strategy, this requires consideration of the risk (probability and consequence) of building component failure, the required customer expectations, proactive maintenance costs, and condition monitoring costs. Unlike those building components which can justifiably be operated to failure, for proactively managed building components, risk must be determined in the absence of a failure history. In this case, failure probability for the determination of risk must be established by either condition monitoring or degradation modelling.

### Performance approaches

It is apparent that the variation in the capacity for housing support among settlements is significant. The ability to pay for a specific level of service is the critical issue. This depends on regional economics and settlement expectations. The levels of service provided by housing authorities may, and indeed should, vary significantly. Issues such as different management and operational strategies have an impact on the delivery of customer service levels. The challenge is how best to manage with limited replacement funds, while maintaining a satisfactory level of service.

There are three levels of portfolio management:

1. strategic – ensuring the right mix of properties
2. tactical – ensuring the properties in the portfolio meet the requirements of the owners and tenants
3. operational – ensuring the properties achieve maximum value to the managers, and that the maintenance program is carried out.

Due to these three horizons, portfolio managers are often confronted with a range of alternative budget expenditures, and are in need of a tool that allows systematic assessment of the portfolio. The long-term cost implications of poor asset management practices are significant. For an approach to be successful, a maintenance philosophy and specified objectives should provide maintenance to:

- ensure the health and safety of tenants
- maximise the utility of assets
- ensure compliance with standards and regulations
- minimise impact on the environment
- minimise lifecycle costs
- ensure appropriate record keeping
- improve processes and management capability.

### Strategies, indicators and data

A key project activity was to develop ways to maximise the value from existing data, in particular, data collected for funding purposes. This data is regularly collected to satisfy reporting requirements and to support funding claims. The data collected varies across the different portfolio owners and managers, complicating the development of a one-size-fits-all model. The usefulness of the asset management system depends on the quantity and quality of the data available and the accuracy of the underlying asset failure models.

In Australia, the *National Housing Data Agreement* (Australian Institute of Health and Welfare 1999) has provided authorities with guidelines for a minimum housing data set and performance indicators. The reporting requirements have resulted in authorities collecting significant amounts of data; while this data is largely collected for the purpose of reporting, some have recognised the potential and are actively using the data for managing maintenance and upgrade programs. Obtaining the full value from the data, however, would require extra effort because reasons for failure are often not recorded and the consequence of failure not considered. As a result, effective prioritisation cannot be accomplished.

The revised *Commonwealth–State Housing Agreement* (2003) has required authorities to demonstrate effective asset management through a range of Key Performance Indicators (KPIs). Overall, 15 performance indicators for public housing were developed. These include nine key indicators and six secondary indicators.

The nine key indicators relate to:

- total amount of assistance provided
- targeting of assistance to those most in need
- affordability of the assistance provided
- the standard of rental housing provided
- match of dwelling to household size
- timeliness of assistance
- consumer satisfaction
- efficient use of housing assets
- value of housing assets.

The six secondary indicators relate to the operational efficiency of state housing authorities and include:

- the administrative and operational costs of public housing
- the provision of direct subsidies to tenants
- the cost of stock production
- the management of rent arrears
- the cost of turnaround rent forgone
- the turnaround time between occupancy of stock.

Development of these asset management tools provides managers with the ability to report on these KPIs with relative ease, providing there is a systematic data collection process in place that results in quality data. Further, these tools enable planning for portfolio management over the three horizons. The more detailed the data collected, the better the tool's ability to deal with the planned maintenance activities and the better managers can estimate the budget required for reactive maintenance activities. These tools also help predict which resources may be needed and whether the activities are time or event driven.

Planned maintenance activities are essentially time driven, while responsive maintenance activities are event driven. In Figure 8 above, the circled areas or 'voids' represent opportunities to complete a service on a property or upgrade as required.

A critical component of reactive maintenance is to be able to forecast the expected annual number of failures for each type of building component for a set number of years, based on the operating and installation environment of each component. This information can be generated through an asset management tool by a series of customised failure curves for each building component (based on statistical or physical/probabilistic models), determined through analysis of the asset data. This includes the impact of component quality, environmental effects, usage factors, and quality of maintenance. For each building component, the expected failure rates can be estimated for each year in the forecast period, based on the age and exposure conditions of the component in that year. The total number of failures in the system in any year is the aggregate of the failures in each component; so the inventory of the actual building components enables the full building performance to be calculated.

An essential aspect of any planning model is scenario generation, as the performance requirements for the housing stock can differ significantly, such as different levels of customer expectations and usage behaviours. Once the performance requirements of the housing stock have been established, these scenarios should be able to be simulated to see what effect they might have on the resulting costs.

Once the long-term implications of different management and operational strategies have been assessed, a budget using the above approach can be developed to meet the year-to-year maintenance and planned rehabilitation needs of the housing portfolio. Following this prioritisation, models can be used to focus on allocating funds to maintenance of specific building components. Any replacement prioritisation model should:

- build on the planning models
- determine priorities from the predicted failure scenarios
- determine the effectiveness of macro renewal/repair strategies

While this provides good guidance for spending renewal budgets and selecting general strategies, a more detailed analysis on a micro level is needed to efficiently target those building components where the net benefits of renewal are likely to be the greatest. This means that different authorities often have different problems, requiring different solutions, and standardisation of the processes involved may be difficult.

It also means that efficient communication and cooperation between housing authorities may be hindered by different priorities. The main feature of any prioritisation tool should be to allow the user to rank building component replacement by assessing the relative risk of predicted building component failure and the social (health, safety, family integrity), environmental (flooding, loss of housing), and financial consequences (cost of repair and replacement, failure to support livelihood).

## Review of existing model condition indices

The methodology used for development of condition indices falls into either of two categories:

- cost-based condition indices
- function-based condition indices.

Cost-based methods do not consider the function of the component; rather, they use a measure of the state of disrepair of a component, and value the cost of returning the component to as-new state. Function-based procedures require inspection of the components of an asset and a technical assessment to be made based on the ability of the component to carry out the function and provide optimal performance. This method uses concepts like remaining-life or utility of the components to assess the condition of an asset.

In each case, assets must be reviewed down to component level. When a dwelling, asset or facility is reduced into its elements, it enables a more accurate assessment of its condition. The data on the specific elements needs to be accurate and the accuracy must be maintained by regular audits.

### Cost-based condition index

Cost-based condition assessment is mainly used in portfolio asset management. In essence the process requires an asset to be divided into components and the components then physically inspected. The inspector provides expert assessment of the state of disrepair and the estimated cost of returning the component to as new status. These individual costs are then summed and the total represents the state of disrepair of the asset overall.

### Housing Stock Condition Index (HSCI)

The Housing Stock Condition Index (Tucker et al. 1996) was created by combining the condition measure for a dwelling with weightings related to each dwelling, and summing the measures to provide a total. The dwelling is considered to consist of a number of components for which the cost of the required maintenance can be assessed, with the components covering all parts of the dwelling which can be repaired and/or replaced. Hence the Required Maintenance (R) value of a dwelling is calculated as the sum of the work required on each of the components.

The recommended dwelling condition weighting is thus based solely on the cost of provision of the dwelling. The condition of the more expensive dwellings makes a larger contribution to the condition indicator for the whole stock than the condition of the less costly dwellings.

As for the Dwelling Condition Index for a single dwelling, a most useful feature of this Housing Stock Condition Index is that only the totals are required; the number and identifiable contributions of individual dwellings are not necessary. Thus, the HSCI for the whole stock can be found from the state of the components and the capital replacement costs of the dwellings.

In order to measure condition, there needs to be a standard against which the current condition can be compared. This standard will define what capabilities are required in an acceptable dwelling, and what degree of deterioration is required before a component is considered to be out of condition.

The recommended housing stock condition indicator provides each jurisdiction with the ability to assess its own stock against its own pre-determined standards. It is based on all house components scoring above a set level before the house can be assessed as 'meeting the standard'. However, the standards of acceptable deterioration will have to be investigated to see if the deterioration is comparable between jurisdictions before the Housing Stock Condition Indicator can be used to make direct comparisons between jurisdictions.

The Dwelling Condition Index (and HSCI) only requires two kinds of data items, the total cost of required maintenance to bring the dwelling up to the acceptable standard, and the capital replacement cost of a dwelling. These totals must be calculated from a consistent definition of the total coverage of what constitutes a dwelling but there is no specific requirement for a uniform set of components applicable across all housing authorities.

The condition index can be applied all the way up from a single component, which has been accurately assessed by itself, to elements of dwellings, to dwellings, to groups of dwellings (by regions or by type), to total stock by state/territory and country as long as the values are all calculated on the same basis. This approach was the basis for the development of the Property Standard Index used by the Queensland Department of Housing to assist in the management of their property portfolio.

### Facility Condition Index

The Facility Condition Index (Vanderweil 1998) is a method similar to that of the HSCI. The method requires inspection of buildings by components based on physical analysis. The elements are then summed to component level, and then the components are weighted and aggregated. The weights are termed 'condition value multiplier'. The weights are approximately equal to the percentage of total building cost that each element represents. The survey carried out to compile the data provides both a description of the major components and an analysis of the building and enables the rating to be determined. The formula requires summing the estimated cost of repair and then dividing by the sum of the replacement value of the components. The replacement value is the market rate of the component adjusted to meet the current specifications and includes all associated costs. As is the case with the HSCI a steady increase in the overall rating indicates the maintenance program has been successful; or conversely, if the rating indicates the building is deteriorating the maintenance program needs altering.

The Facilities Condition Index is a budgetary tool whereby the maintenance program determined is undertaken to keep the physical value of a building as close to 100 per cent as possible. The maintenance investments are considered under three categories:

- repair and maintenance, which can be considered preventative maintenance

- renewal, which can be viewed the same way as depreciation, but consideration should be given to the lifecycle of the components (rather than a straight-line depreciation, the curve should probably be more a cyclical wave curve)
- deficiency correction, which can be minimised by timely preventative maintenance and renewals (change in building codes will affect this category but the need for physical improvements should not be considered as deficiencies).

## English Housing Condition Survey (EHCS)

The English Housing Condition Survey carried out by the Department of the Environment Transport and the Regions in the United Kingdom, is accomplished in much the same manner as the survey being undertaken by the Queensland Department of Housing. The dwellings are segmented into elements, these elements are then inspected and the expected repair costs are estimated and recommended repair time frames are indicated – ranging from urgent (zero) to ten years. Urgent repairs were defined as those that require repair and present a risk to the health, safety, security or comfort of the occupants and also those repairs that will forestall rapid deterioration of a dwelling. Expected repair costs were estimated.

A separate survey was carried out to determine the current market values of the components to enable standardisation. The major difference between this survey and that currently being carried out by the Queensland Department of Housing is the size of the survey. For the EHCS the inspections were done on samples from specified populations only, not on the entire population. Another significant difference in the EHCS is that the replacement years were only defined for external elements.

The output was a score for quality represented as a single number with emphasis on the strengths and weaknesses of the housing scheme. The output allowed comparison of each of the elements to signal areas of proficiency and deficiency. Failure to meet minimum standards rendered the dwelling uninhabitable. In this appraisal method older dwellings that were built under different standards will register a lower score than new dwellings, because the minimum standards are not adjusted to fit these cases.

The Housing Quality Indicator included site location and aesthetics in the quality assessment. As these measures are subjective, they would bring bias into the equation. These elements will also prevent direct correlation with the financial value of the buildings.

One of the ultimate aims of the development of a Housing Quality Indicator was to enable developers and consumers to compare dwellings in a meaningful way. The system will also allow developers and designers to critically review design issues with regards to attribute types and other factors and enable them to learn from their successes and mistakes.

## Homecheck

The Defence Housing Authority employ a method known as Homecheck (Bycroft & Vöelè 1993). The first survey was carried out in 1991. By this method, the tenants carry out the survey and the data that is collected meets two purposes:

- indicating the building's performance
- providing a means for maintenance management.

Buildings that do not perform can be identified and adjustments made. The surveys also allow comparisons to be made of the stock condition over time. One of the major benefits of the index has been the ability to compare components by areas and, as subsequent surveys are carried out, to compare components against their previous rating to determine the level of improvement for the component.

The tool allows ranking of the components according to worst condition, which helps with prioritising and budgeting. It is useful when considering factors affecting wear (for example, a comparison can be made of the component type by area by level of disrepair).

The database collected also enables the percentage of stock with or without specific attributes to be determined.

### Function-based Condition Index

The function-based method is generally used to assess the condition of facilities where the failure of relatively minor components can impact heavily on the performance capabilities of the facility. This technical assessment is used mostly in monitoring infrastructure such as roads (pavement appraisals) and railway. This assessment method focuses on determining the rate of deterioration by rating the condition of components in a technical manner by measuring the component and comparing it to a new component. It is used by many organisations for infrastructure.

### Function-based condition indexing for embankment dams

A paper by Andersen & Torrey (1995) reviewed developing condition indices for aging civil engineering facilities. The authors distinguish between ageing and new facilities due to the different maintenance schedules and technological background of the facilities.

The object of this method is to evaluate and prioritise maintenance and rehabilitation expenditure. The method requires the facility to be divided into sub-units. The conditions of the sub-units are assessed and then the scores are grouped and weighted. The scores are assembled into an assessment vector, which is then crossed with the appropriate weight vector to give an overall condition index for the specific facility.

With this type of asset, deterioration of one element can affect the rate of deterioration of another element. Given this, an interaction matrix is developed to allow for this type of interaction. The interaction matrix is included in the equation to provide an accurate condition assessment. The condition is determined by experts in a technical manner but is subjective: if there is a disparity in the assessment, a panel of experts reviews it and the consensus is accepted.

Following on from function-based condition indexing for embankment dams, the authors expand on the weighting vector. Ranking models are developed for prioritisation of maintenance and for determining the appropriate weighting vectors for the index. The method outlined relies on statistical processes and is based on historical data for the elements.

### A decision support tool for managing the nation's aging infrastructure

The condition index by Rens et al. (1994) ranges from 0 to 100 and is used to focus attention on those structures that warrant immediate repair. It is primarily a planning tool. The scoring is again carried out by experts, but it is subjective. The main criteria for scoring the facility are serviceability and safety. The technicians who inspect the facility interpret critical measurements based on listed standards and the scores are weighted according to the opinion of the experts as to the importance of the components and levels of distresses. The weights are adjusted for the severity

of the distress. This adjusting factor can alter the score by up to a factor of 8. Due to the subjective nature of the assessment there is likely to be variability in the scores. Those interpreting the results should keep this in mind.

### The National Health Service – Hospital condition appraisals

One of the goals of the program discussed in the article by Smith (1985) is to develop a ten-year financial replacement schedule. The initial assessment was for the current maintenance backlog. To compute the current condition, each estate is segmented into 19 elements, and each element is assessed for its condition. The assessments are subjective, but made by qualified officers, and assume the current maintenance program will continue for the life of the element. The expected remaining life is necessary to determine the condition and is deemed as the time before the element reaches serious risk of breakdown or to health or safety. The expected costs of repairs are the costs required to return the element to sound condition. If an element is generally considered to be in sound condition, but part of the element needs urgent attention, it is rated as sound, but a special note is made. Provision is made on the survey form for comments allowing officers to expand on their assessments if needed. It is recommended updates of the data be carried out annually to ensure the appraisals are current. The condition appraisal will allow condition information for any element in specific areas.

### Development of condition indices for low volume railroads

The process for developing the condition rating required the tracks to be divided into elements, each element was assessed and the elements were then grouped and weighted to provide an overall assessment of the condition. According to Uzarski, Darter and Thompson (1993), the assessment is made by a visual inspection of a sample of the network by experts who make subjective assessment during periodic safety inspections. The assessment is technical in nature and is based on a specified traffic flow and minimum track structure. For assessing condition of timber sleepers, Wirth, Murray and Ferreira (1998) recommends inspectors consider factors such as expected remaining life, percentage of defective sleepers and measures of clustering for defective sleepers. The condition index needs to be objective and repeatable and enables a condition rating to be provided for the overall network, a specific track, their portions and components. The condition index was developed to:

- assess the current track condition
- predict future conditions
- establish deterioration rates
- formulate long-term budgets
- determine and prioritise renewal projects.

### National Survey of Housing Conditions

This system was developed by Canada Mortgage and Housing Corporation in 1990. The survey process was designed to be carried out on a regular basis (every three to five years). One of the criteria to be met was that the condition assessment had to be reliable (unbiased, valid and objective) and repeatable.

The method relies on the technical knowledge and experience of the inspector to rate the specific component on a seven-point scale (as opposed to estimating a repair cost for each element of the component). The inspectors only evaluated ten per cent of the stock and the balance was occupier evaluated. The occupants also rated the components for the dwellings that were rated by

the inspectors and the two scores were compared and a weighting scheme determined to correct the survey responses provided by the tenants/owners through a multi-variate regression analysis (across variables including dwelling age, household income and location.) The occupants could then carry out subsequent surveys and the responses could then be reliably interpreted. A problem encountered with occupier surveys was that homeowners generally provide better responses than renters do.

## Review of existing Lifecycle models

An international literature search was conducted on Indigenous housing, with respect to asset management strategies, lifecycle costing and modelling related to construction, maintenance and repair. The search revealed no overseas reports or papers on Aboriginal housing which related directly to asset management strategies, lifecycle costing or relevant modelling. The information presented below does, however, provide some background on issues related to construction, maintenance and repair for Aboriginal housing in Canada and in the USA. In each case, the situation described seems very similar to that in Australia.

## International modelling

### Canada

#### *Second United Nations Conference Report*

A good account of the issues pertinent to Aboriginal housing in Canada is contained in the *Canadian Government Report on Aboriginal Housing*, presented at the Second United Nations Conference on Human Settlements (Habitat II), Istanbul (1996). The following excerpts from the report constitute a useful summary:

Despite decades of public housing services delivered to remote settlements, Aboriginal housing needs remain acute. Some of the reasons for this situation are: rapid population growth, shortage of available capital, rapid deterioration of housing stock caused by severe overcrowding, or lack of maintenance. For example, more than half of the 76 000 on-reserve houses need renovation or replacement. The housing shortfall will widen due to deterioration and to an anticipated 50 per cent increase in households over the next 10 years.

The remote location of most First Nations<sup>11</sup> settlements means that all construction costs are higher. Building supply centres may be hundreds of kilometres away, resulting in high delivery costs to First Nations settlements. First Nations in the northern regions of the country face an additional challenge. Their settlements need houses that can withstand extreme environmental conditions, such as severely cold temperatures. These conditions require higher construction standards, which in turn result in higher costs.

Another problem has been the limited life span of houses on reserves. Often, it has been only half as long as it should be. This shortened life span is the result of minimal construction standards, lack of maintenance and overcrowding. For these reasons, about one third of the new houses built each year on reserves simply replace existing homes that have fallen into disrepair.

The report also includes the following information on funding:

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<sup>11</sup> 'First Nation' is a term that came into common usage in the 1970s to replace the word 'Indian,' which many people found offensive. Although the term First Nation is widely used, no legal definition of it exists. Among its uses, the term 'First Nations peoples' refers to the Indian people in Canada, both Status and Non-Status. Many Indian people have also adopted the term 'First Nation' to replace the word 'band' in the name of their community.

- Two federal departments, the Department of Indian Affairs and Northern Development (DIAND) and the Canada Mortgage and Housing Corporation (CMHC) are key contributors supporting initiatives to improve housing conditions among Aboriginal people.
- DIAND allocates \$247 million annually for First Nations on-reserve housing, related infrastructure, as well as shelter allowance assistance where applicable. The funding assists with the construction of approximately 3 600 new houses and 3 900 renovations each year on First Nation reserves. Today, 92 per cent of on-reserve houses have running water and 85 per cent have sewage facilities. DIAND has also guaranteed over \$1 billion in housing loans under its ministerial loan guarantee authority. In addition, First Nations on reserves have access to the social housing programs of the CMHC, which will provide approximately \$130 million in 1996–97 to cover existing and new housing projects. These housing subsidies offset operating and maintenance costs, including loan payments, thus allowing for lower rents.
- CMHC provides a further \$168 million annually for off-reserve First Nations, Inuit and Métis settlements for a range of existing urban, rural, public and non-profit housing and rental supplements.

All Aboriginal people can access several other CMHC programs, including the Emergency Repair Program, the Residential Rehabilitation Assistance Program, Home Adaptations for Seniors Independence and the Shelter Enhancement Program. CMHC also funds capacity-building projects, including skills development and training.

### *Royal Commission on Aboriginal Peoples Report*

The 1996 Canadian Royal Commission on Aboriginal Peoples (1996) included information related to funding and housing stock deterioration:

*A 10-year program, starting in 1997, to bring the housing stock on reserves up to standard, accommodate those now waiting for a home, and provide for future population growth will require an investment of \$5.1 billion. The bulk of this spending would go toward building new dwelling units. Present needs include replacing 6,500 houses and meeting a backlog of 11,000 houses; future needs consist of 30,100 units for new households and 4,000 units that will need to be replaced before better maintenance puts an end to the rapid deterioration of the existing stock. Should implementation of this catch-up effort be delayed, its cost will increase, as the stock would deteriorate further.*

Major repair and renovation is a further requirement. An estimated 14 000 units need major work at an average cost of \$30 000. This proposed activity would in part replace the current minor repairs of some 4 000 units per year, and it would ensure that units are brought up to standard. The cost of minor repairs would be met out of funds for regular maintenance of existing stock as well as contributions by households.

There is also a cost associated with operating newly constructed homes. At a cost of \$2 100 per dwelling for heating and utilities, 5 160 new units per year will result in \$11 million in additional expenses for heating, electricity and utilities. There is also a need for more funding for program delivery.

How can these resources be generated? It is estimated that First Nations settlements generate about \$140 million per year for housing costs at the present time. This includes charges for heat and utilities as well as rental and mortgage charges. Included in this amount is the contribution of about 6 000 households who assume full responsibility for housing and services costs. In addition, First Nations contribute to the cost of construction through training funds and sweat equity.

According to calculations by DIAND based on the 1991 census, only 16 per cent of households on reserves are able to pay the full cost of housing services. Of the other 84 per cent, half can contribute something toward the cost of housing, whereas the other half cannot. Clearly, First Nations settlements are extremely dependent on government assistance for housing. For our projections we assume that First Nations people will be able to contribute one-third of the cost of construction and repair for a catch-up program and one-third of the cost of operating and maintaining the newly built dwellings. This estimate assumes that First Nations people will creatively use all resources at their disposal, as we have discussed. (The estimate is also global and approximate. The contribution will vary greatly from settlement to settlement, depending on the level of employment and income and the availability of materials, skills and other factors.)

## United States of America

### *Department of Housing and Urban Development (HUD)*

In the USA, housing programs for Native Americans are provided predominantly through the Department of Housing and Urban Development (HUD). The following are excerpts which provide an insight into issues related to construction, maintenance and repair of Native American housing, taken from a 1997 HUD report (United States General Accounting Office 1997).

Many factors complicate and make costly the development and maintenance of affordable housing for Native Americans. These factors include the remoteness and limited human resources of many Indian housing authorities and the Indian settlements they serve, land-use restrictions and the inhospitality of the land, the difficulty that contractors and Indian housing authorities have in complying with statutory requirements to give hiring preference to Indians, and the vandalism and neglect that make heavy demands on the scarce maintenance funds available to Indian housing authorities.

*Indian housing conditions are much worse than housing conditions in other areas of the country: 40 percent of Native Americans in tribal areas live in overcrowded or physically inadequate housing compared with 6 percent of the U.S. population.*

In the Western desert, once low-income housing is developed, the severity of the climate can complicate maintenance. The effects of high salt and mineral content in the water and soil were evident at the Gila River Housing Authority, causing damage to water heaters and copper and cast iron pipes. The executive director told us that the average life of a hot water heater costing \$300 is about 6 months. To remedy the corrosion to plumbing, the IHA (Indian Housing Authority) has begun placing plumbing in ceilings and converting to plastic piping. Also, the water's high mineral content damages the water circulation systems of large fans called "swamp coolers," used for summer cooling. The executive director told us that because of calcium build-up, the IHA must replace the coolers annually. He also explained that because of the soil's high salt content, housing foundations and sewer systems also deteriorate more rapidly than in more benign environments.

The Indian Self-Determination and Education Assistance Act of 1975 requires IHAs to award contracts and subcontracts to Indian organizations and Indian-owned economic enterprises. IHA executive directors find that implementing the act's requirement is difficult and believe that the

regulations add to contractors' time and costs to bid on work for IHAs. The officials said that factors that undermine the requirement include a lack of qualified Indian contractors in the area, the creation of fraudulent joint ventures that are not owned or managed by Indians, and the occasional need to use qualified firms outside the region that do not understand local conditions.

If housing units are abused through neglect or vandalism and not regularly maintained, they will require costly major repairs. These avoidable repairs put pressure on maintenance budgets that are shrinking because a high percentage of rents are unpaid in tribal areas. Moreover, maintaining assisted housing for Native Americans is an increasingly difficult challenge because of its age – 44 percent of the units were built in the 1960s and 1970s.

### *Native American Housing Assistance and Self-Determination Act*

The lack of adequate data relating to asset management of Native American Housing in the USA is indicated in the following information extracted from a recent Federal Register entry relating to revisions to the Indian Housing Block Grant Program Formula (USA Federal Register 2005):

*The Indian Housing Block Grant (IHBG) Program Allocation Formula currently uses an adjustment factor known as the Allowable Expense Level (AEL), which serves as a substitute measurement of geographic and other differences in the monthly per-unit operating costs incurred by an Indian tribe to operate Current Assisted Stock ...*

*During Committee deliberations, several members, including HUD, expressed a desire to replace the AEL with a more current, accurate, asset-based measure of the costs to operate well-run housing in tribal areas. It was acknowledged, moreover, that at this time the data and methodologies necessary to implement such a system have not been developed. HUD has begun to undertake a comprehensive study of well-run tribal housing.*

### *Key statistics*

A useful comparison of key statistics (Table 3) from the USA, Canada and Australia, relating to Aboriginal housing, is provided in Moran (1997):

Table 3: International comparisons of Indigenous housing

Indicator	USA (Reservations only)	Canada (National)	Australia (National)
<b>Aboriginal population</b>			
Housing units	112,200	239,240	76,000
Owner occupied	67%	41%	24%
Tenant occupied (renting)		49% <sup>1</sup>	69%
Average home occupancy <sup>2</sup>	3.9	3.5	4.6
Average no. of rooms	4.4	5.8	-
In need of major renovation/replacement <sup>3</sup>	35%	26%	38%
<b>Total population</b>			
Owner occupied	64%	63%	71%
Tenant occupied (renting)		37%	26%
Average home occupancy	2.29	2.7	2.6

Sources: USA: Census, 1990; Canada: RCAP, 1996 (submitted by Dussault et al. 1996); Aboriginal People's Survey, 1991 <http://library.usask.ca/data/social/aps.html>; Canadian Mortgage and Housing Corp, 1996; Indian and Northern Affairs Canada, 1996c; Australia: 1991 Census (ABS 1994); ATSC 1992.

<sup>1</sup> Excludes band-owned housing.

<sup>2</sup> USA figures for home occupancy and rooms are median values. Canada and Australia figures are mean values.

<sup>3</sup> Figures are for housing on reserve and/or under the control of Indigenous Housing Organisations.

## Australian Remote Housing models

### Australian Institute of Health and Welfare (AIHW) model

A housing maintenance model was included in a study carried out for the Australian Institute of Health and Welfare (Sheehan, Jenkins & Phillips 2001). The objective of the study was to:

*...bring together currently available data and use suitable data to construct a model that would inform decisions regarding how funds were spent between construction of dwellings and their maintenance. This approach is designed to assist administrators and communities in understanding the impact of resource allocation decisions in one year on the levels and condition of stock in future years.*

A simulation model of the lifecycle of housing was created using iThink software; however, the limited availability of data meant that the model would only operate at a general level and had to be adaptable to better data or changes in the model itself.

A comprehensive review of Aboriginal housing data sources was conducted with a focus on geographical factors, dwelling characteristics, and dwelling use. It was concluded that data availability is an inherent problem for modelling long-term assets and depended on:

*...those [data items] that are relevant to their administrative purposes and often do not include important factors that are relevant to understanding the progress of housing through its life cycle.*

In their model, geographical factors included distance from services, climate, pollutants, vegetation and soil. The dwelling characteristics were restricted to dwelling level descriptors such as type, construction materials, size, orientation, age, number of bedrooms, and maintenance requirements and costs. The dwelling use factors were grouped under two headings: settlement and tenant. The first focused on settlement size, infrastructure, asset management and health aspects while the second dealt with overcrowding, socio-economic status, education and skill levels and health.

Considerable effort was expended on determining cost indices for housing in various regions throughout Australia, from capital cities to rural towns and interpolating or extrapolating as required for size and remoteness. The cost data came mainly from *Rawlinsons construction cost guide for housing, small commercial & industrial buildings* (cited in Sheehan et al. 2001) which, while comprehensive, was established for typical town and city dwellings. The relative proportions of space such as indoor living versus veranda, kitchen and bedroom needs and fittings can be very different for Aboriginal housing, and no allowances were made for these differences. Lightweight, heavyweight and combinations of both types of structures continue to be debated as to their lifecycle value. Costs at a dwelling level can be no better than averages based on dwellings, which may be quite different in design in a remote settlement.

Overcrowding was defined and its effect was addressed. While recognising the inadequacies of the standard method of defining overcrowding (people per bedroom) to measure deterioration of a dwelling, the method was used as no new data was available to justify using any other approach. Even the increasing relationship between repair and maintenance trend with the standard measure of overcrowding, as presented, was less than convincing.

There is no clear definition in the model of the exact aggregated costs. There is reference to Rawlinson's lifecycle costing model – a standard approach to lifecycle costing including discounting. However, the costs presented as outputs are not defined and due to the lack of any mention of discounting, it can only be assumed that the totals are simply aggregates.

Only the general principles and the types of relationships in the simulation model are described in the text. For simplicity, the life of the dwellings is broken down into five-year blocks, for which occupancy rates and maintenance levels can be set. The level of maintenance from 'none' to 'required' can also be set.

The model appears to have been developed for easy testing of scenarios, in that the inputs have simple choices or sliders to set input parameters. The outputs are similarly designed to provide the key information. The model permits a wide range of scenarios to be investigated and some results of varying maintenance levels, dwelling type, and occupancy rates are presented. For example, zero maintenance results in a lifetime of about 14 years, while full maintenance gives a much longer life of about 40 years. Estimated condition over time (usually declining) is also available.

The costs of three alternative scenarios – no maintenance, half maintenance and full maintenance – are provided from two points of view: costs over a fixed period (e.g. 20 years) and the life of a building. The former is the most useful to those providing housing services.

The conclusions clearly identify that there are many factors of dwelling use that impact on longevity, and hence maintenance demands, but little or no data exists on the matter. Similarly, the shortcomings of using city-based cost data are clearly stated and the need for better data becomes a recurring theme.

The report proposes a long overdue National Indigenous Housing Management Data Plan. The development of the model clearly shows the inadequacies of the data and this is reflected in the model.

### SGS and Urban Resources model

A housing maintenance model was included in a study by Spiller Gibbons Swan (SGS) with Urban Resources (2000) and later developed in more detail by Flood (2002a). The SGS/Urban Resources study had a broad range of objectives, of which a model for target setting was only a minor part. In relation to housing maintenance, the study concludes that:

*These higher maintenance costs of Aboriginal housing reflect:*

- *High occupancy levels*
- *Cultural differences in the way houses are viewed and used, which may result in extra costs*
- *High costs in remote locations*
- *Lower rents and higher arrears.*

*There are both extra costs and savings relating to site development and land in rural areas.*

*In summary, the key financial features of Aboriginal housing are the high deficits and high depreciation rates, conducted within a capital funding framework which does not contain any recurrent component and therefore requires high levels of implicit subsidies from many different sources.*

A simulation model of maintenance and housing quality over time was developed and it aimed to show (SGS & Urban Resources 2003):

- the long-term effects of recurrent deficits under a steady funding regime
- the effects of higher and lower depreciation levels on budgets and stock accumulation
- the difference between low and high maintenance strategies

- different objectives, including maximising client benefit and maximising total stock
- the effect of improving rent collections.

The study also stated that:

*...because of scanty data, the model is intended to illustrate general principles only; however with better data it could be used to calculate expected stock levels over time, for the whole IHO stock, for particular parts of the stock, or for individual organisations.*

More details of the model and its application were later presented in Flood (2002a). The essentials of the model are as follows:

*There are four classes of dwelling; good, medium, bad, and unusable, which are typified by the percentage that they have deteriorated. In addition to standard depreciation, there is added wear and tear depreciation to allow for heavy use.*

- Depreciation can be reduced by maintenance expenditure and upgrading can be achieved by capital expenditure.
- The fourth class of dwelling is beyond repair and no work is done on these.
- Grant funds may be used for new construction or for maintenance.
- The model heads towards a steady state (after 15–20 years) of a mix of dwelling classes independent of the original stock but dependent on the strategies for expenditure on the houses. The model is subject to many qualifications, including that it is ultimately restricted by the lack of any accurate information on the quality of the stock, the annual rate of depreciation of the stock, and the actual budget deficits involved.

Another area that requires investigation is the relationship between occupancy and deterioration. If it is in fact true that much of the extra deterioration is due to high levels of occupancy, then increasing the numbers of dwellings will cause a fall in the rate of depreciation (only if cultural practices also encourage a lower occupancy rate – this assumption is yet to be tested – as many houses are currently not permanently occupied).

Nevertheless, the model demonstrates some very strong general principles:

*In general, a repair strategy will result in more housing and better present values than a build and abandon strategy – but the final quality of the houses will not be as good on average.*

*With large deficits, which are made explicit, the existing funds will eventually be consumed by the deficit as the stock expands, to the point where the stock can expand no further (and may even shrink) [this happens with a constant strategy which does not change when demand changes].*

*The final numbers of stock reached are very sensitive to the net deficit.*

The model shows the effects of different strategies and different rates of depreciation on the number and condition of houses in a housing organisation at a house level but does not consider the causes of high maintenance expenses. It does show what happens in the long term for various strategies for funding. The model produces a number of insights into maintenance and construction strategies under conditions of high depreciation, which are commonplace in Aboriginal settlements. The model shows that a high repair strategy will result in more houses, but these will be of minimum quality. A high construct strategy will maintain something like 75 per cent of the number of houses, but these will be in much better condition. Flood (2002a) concludes that:

*While the equilibrium levels of housing in this model can be solved analytically, a true dynamic optimization model has yet to be constructed, and these can reveal many complexities in finding an optimal strategy.*

## Housing data

### The necessity for good data

Managing a small number of properties can be achieved through visual inspection and action, but achieving improved outcomes with a portfolio of many tens, hundreds, or even thousands of properties depends upon the collection of appropriate, timely, and good quality data. Often data is collected to meet a reporting requirement rather than specifically to manage an aspect of the portfolio and has limited use for other management activities. There are a number of criteria when assessing data for its suitability for such a use. Data should be:

- relevant
- accurate
- complete
- repeatable.

Ideally, the collection of data should not impose any extra cost or effort pressures on the housing managers. The data should be able to be collected as a matter of course or incidentally while completing other activities.

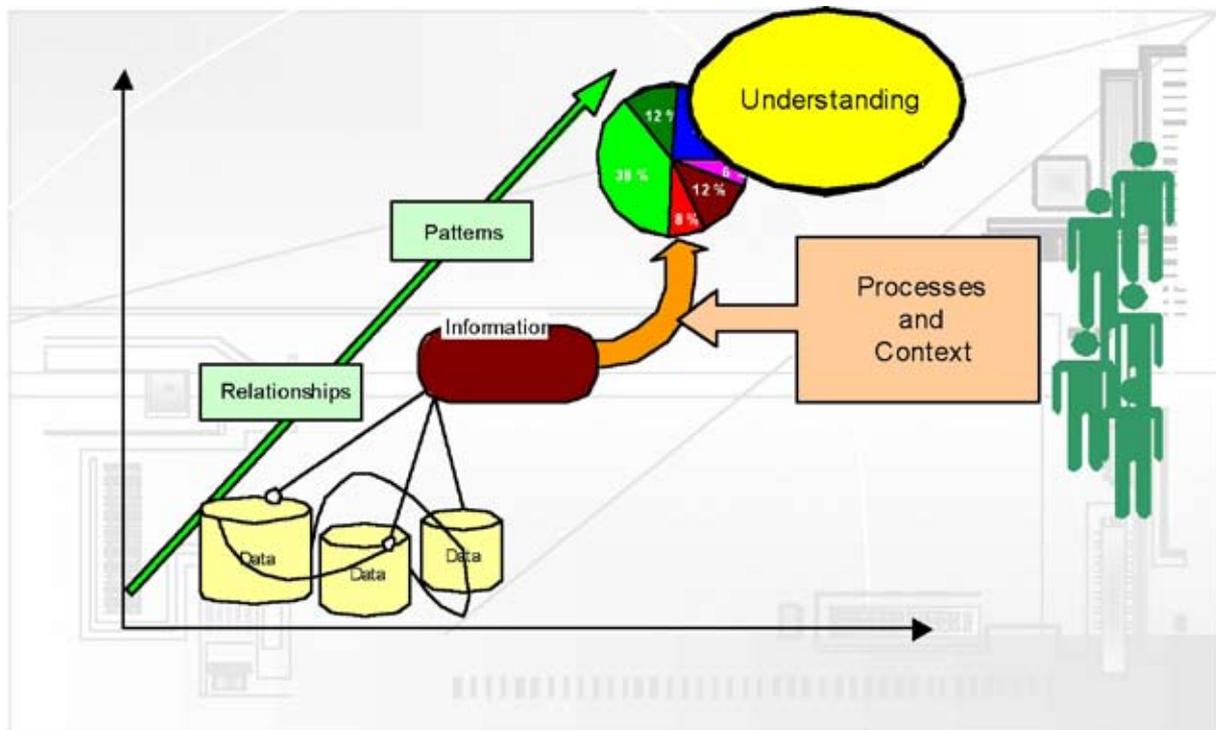


Figure 9: Data-to-understanding conceptual diagram

Data on its own is of little use. It requires supplementation with contextual information: whether there is access to resources to deliver action, and what management processes are in place to plan and coordinate the activities required (Figure 9). Bringing together these elements in a relational form will result in information that will lead to understanding. This enables corrective action to

be carried out. Condition data, when combined with other portfolio data, can be successfully used by portfolio managers to carry out various management tasks from strategic through tactical to operational tasks (Tucker et al. 1996; Vanier, 1999).

However, there is a real risk of apparently appropriate and justifiable decisions resulting in poor outcomes due to poor data. Data quality is the key to achieving improved outcomes.

### Data requested

One of the research activities was to gather the data collected by various agencies and assess it for its suitability. Over the course of this research, housing asset management data was sought from various agencies. Model development was limited by the quality and speed of release of data. This was hampered by the fact that some data was not in electronic form.

The following data was requested during the project:

- ATSIC's Community Housing and Infrastructure Needs Survey (CHINS)
- Fixing Houses For Better Health (FHBH) data
- Various field notes from government agency staff
- Maintenance items and costs
- Settlement data including location and population
- Process information
- Property standards requirements
- Housing plans and contracts
- Various other pieces of support data.

### Data acquired

Data (Table 4) was acquired from the various levels of government:

- Federal – Community Housing and Infrastructure Needs Survey (CHINS) through the Indigenous Housing and Infrastructure Branch (IHIB) of the then Department of Family and Community Services (FaCS).
- Northern Territory – Community Information Access System (CIAS) data through the then Department of Community Development, Arts, Sport and Cultural Affairs (CDASCA); Government Employee Housing data from the NT Government Building Asset Management System (BAMS) through Department of Infrastructure, Planning and Environment (DIPE)
- Settlement – data provided by Tangentyere Council, a government-funded resource organisation, which represents the interests of Aboriginal people who reside in 18 Town Camps near Alice Springs. The organisation has its own works and design departments, which design, construct and maintain houses. Data was requested from Amoonguna, and although there was a willingness to support the project, the data could not be supplied at the time.

Data was also requested through NT Housing from their Asset Information System (AIS) database and through DIPE from their HOMES database. Both of these sources would have provided data on public housing throughout the Northern Territory. This would have enabled comparisons to be made in terms of property conditions and maintenance expenditures, potentially revealing to the housing agency using the software where processes could also be improved. Data was also requested from Fixing Houses for Better Health (FHBH), with no success at this time.

Table 4: Data sources

Source	Coverage
IHANT (CIAS)	Community housing R&M data Community survey data EH survey data
Tangentyere	Detail on maintenance expenditure
DIPE	Spatial data, Government employee housing
NT Housing	Public housing maintenance and condition data
FaCS/ABS	CHINS
ABS	Other

In addition to the data, a number of documents were collected and reviewed to determine their value/usefulness. Two of the documents providing valuable input into the analysis were:

- National Indigenous Housing Guide (FaCS, 2005)
- Environmental Health Standards for Remote Communities in the Northern Territory (NTG, 2001)
- Many documents offered valuable policy information and background/setting information.

### Data management

All data was uploaded into MS SQL Server 2000. The data was reviewed for consistency and linked by a number of data cubes. Differences in coding terminology resulted in considerable effort being expended in mapping and matching data. From the data cubes, appropriate measures were defined and the data viewed by identified dimensions, such as costs per unit, total costs, frequency of visits and so on.

There is a need to standardise coding for consistency, possibly through the introduction of a data dictionary or some standardised definitions of coding, which will lead to consistency across the various management and administrative boundaries.

### Nature of acquired data

#### CHINS

Data from the Community Housing and Infrastructure Needs Survey (CHINS) was provided through the Indigenous Housing and Infrastructure Branch (IHIB) of the then Department of Family and Community Services (FaCS). The data was extracted from the 2001 survey and compiled into three Excel spreadsheets. The survey collected information on all Aboriginal and Torres Strait Islander housing organisations and discrete Aboriginal and Torres Strait Islander settlements throughout Australia, namely:

- housing data
- housing location data
- housing organisations data.

Information provided included:

- details of the housing stock, dwelling management and selected income and expenditure arrangements of Aboriginal organisations that provide housing to Aboriginal and Torres Strait Islander peoples
- details of housing, infrastructure, education, health and other services available in discrete Aboriginal and Torres Strait Islander settlements throughout Australia.

Details of the variables available are provided in the data dictionary for ATSI's 2001 Community Housing and Infrastructure Needs Survey (ABS 2001).

## CIAS

Condition survey data was provided by the CDASCA in the form of data dumps to Excel spreadsheets. The data provided covered settlement housing surveys from Aboriginal settlements carried out by IHO officers over the period from 1996 to 2004. The data contained a total of 245 fields. In all, there was provision for more than 3.65 million data entries with approximately 870 000 cells populated, translating to an entry fill proportion of about 25 per cent. The 245 fields were populated at varying proportions.

Data quality in terms of data entry error was assessed to give a measure of the data value. The data coding used was not easily interpreted, which led to follow-up requests for code tables.

Field names for data provided were not the same as the general codes table, making interpretation difficult; each field had to be assessed on the cell contents to determine the correct field name. The net result was the same, although the time taken to achieve the result was much longer.

Data fields were reviewed for entries containing values not listed in the code table. Many fields contained entries which were interpretable, but incorrect. This type of inconsistency required considerable effort to correct in order to enable analysis. The correctness of the entry was not able to be verified because the data was from a subset of acceptable values, but may not have been the correct value.

CIAS data covering the period 1999–2004, which included the following tables, was provided:

- settlement
- settlement demographics
- settlement lot
- settlement name
- department officer
- grant data
- grant planned releases
- grant project work
- housing management support
- lot survey
- lot survey facility item
- payment journal.

The data has enormous potential and could support a strategic management application if the issue of data quality and completeness was rectified. Data quality could be managed within a database, but it would prove to be more useful and less difficult if there was greater quality control for data collection and entry.

## *NT Public Housing*

The Department of Infrastructure, Planning and Environment (DIPE) made available an Access database which contained five tables (the BAMS database). The database contained details on the estimates of future expenditure and historical expenditure (maintenance and capital) for remote housing, covering the period from 1999 to 2004. Asset register data was also provided. In BAMS, the location table had details providing information on the number of properties in each suburb, which can also be defined by a number of political and cultural boundaries. The asset table provided some detail on the asset. However, the type descriptor is not readily useable.

The estimates table provided detail that should allow an understanding of the property condition but does not contain the detail apparent in the CIAS data. The expenditure data had some 21 000 entries detailing the maintenance and capital expenditure for the properties. Expenses total about \$1.8 million/year for approximately 2000 properties. The coding was not easily interpreted and the task of re-coding may provide some difficulties since 88% was expended under the trade code database (placed in the wrong database fields).

The location table has details providing information on the number of properties in each suburb, which can also be defined by a number of political and cultural boundaries. The asset table provides some detail on the asset. The type descriptor, however, is not easily useable and will require some effort to manipulate for use.

It is hoped that between the coding and the descriptive information a better picture can be created. To date, the amount spent on a property and when it was spent, can be determined, as well as other details on the property such as location and the current condition. The property type is less clear, as is which components were maintained. This detail will require considerable future work.

At the time of this phase of the research (over 2005–2006), there were 1916 properties in the database. This dataset contains properties other than those in remote regions. An asset type code may be able to categorise the properties into groups of interest, but the coding used is not easily interpreted.

There is approximately \$9 million (\$1.8 million/year) in maintenance expenditure on about 1850 of the 1916 properties with a planned/unplanned ratio of 30:70. (Note that this is a provisional statement as maintenance classification codes were not clarified.) About half of the properties receive some form of maintenance each year by trade personnel. These figures also imply that the rest of the maintenance does not require trade personnel.

#### *Potential of housing technology innovation in the market*

The findings above align with those of Seemann (1997), and Parnell and Seemann (2005), who suggest the type of housing technology selected for remote settlements substantially directs the degree to which full traditional trades are required to construct and especially undertake most repair and maintenance on site. That is, increasingly, semi-modular and modular housing technologies are appearing on the housing market, which substantially reduce the legislative requirement for the full degree of trade qualifications usually required to undertake the kind of repair or on-site assembly tasks involved, due much to the housing technology being pre-constructed off site. This innovation promises a local increase in livelihood engagement in housing technology at more socio-economically sustainable levels while also extending the lifecycle of the dwelling and potentially gaining more value out of social housing investment demand.

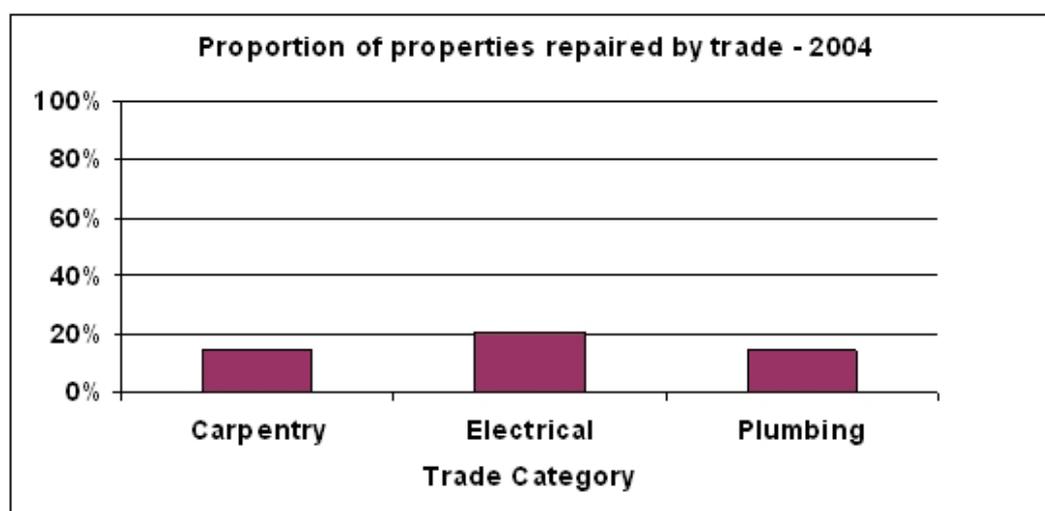


Figure 10: Proportion of public housing properties maintained by trade (2004)

### Settlement data

One of the settlement organisations in the Alice Springs region made available a complete Access database and included a number of tables. Particularly relevant to this study are six tables relating to maintenance activities with records for approximately 8000 jobs and a table detailing the specific assets. Many of these fields were not populated or were incomplete. The database was uploaded into the SQL Server; during the upload 11 tables incurred errors due to data characteristics, but modification and exclusion of selected fields allowed an upload. The database contained approximately 8000 maintenance entries for 344 asset entries. There was also general data on a number of areas managed by the settlement.

The properties range in age from 1 to 26 years old, but many properties do not have the construction date recorded and are believed to be older than 26 years (Figure 11). Anecdotally, there are a number of houses approaching 40 years old.

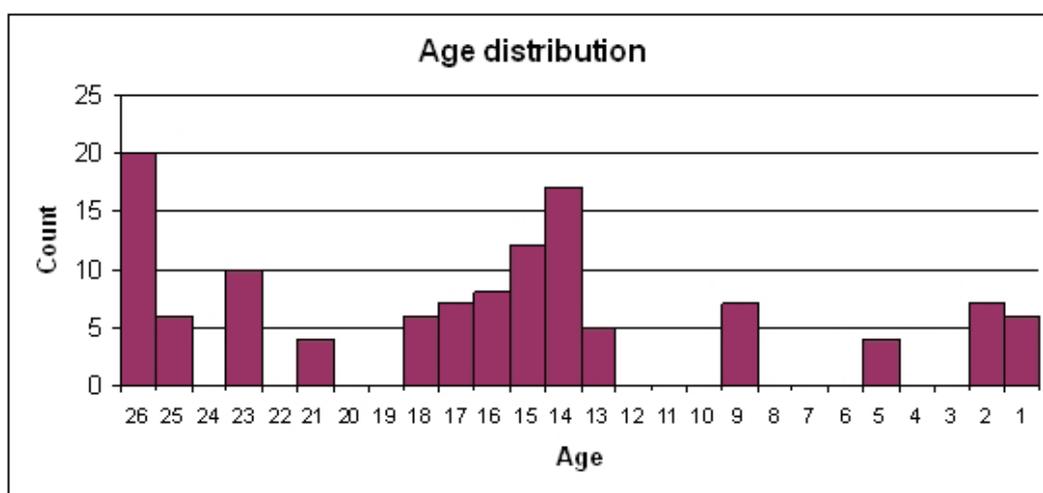


Figure 11: Distribution of known dwelling age for sample settlement properties

The dominant wall type is concrete block, although a large number of properties have no records for the wall type. Three and four bedroom properties are most common. Galvanised iron is historically the typical roofing material used; however, Colorbond zincalume steel sheeting is the standard product used in the newer dwellings. Most properties are connected to sewerage, with only eight recorded as having a septic sanitation system. These properties were all older properties and as such it can be assumed that there are a number of other properties using septic systems. All houses are recorded as Slab on Ground (93) or Null (no slab on the ground).

In terms of maintenance during the period covered by the data almost all properties received attention for carpentry, electrical and plumbing jobs (Figure 12).

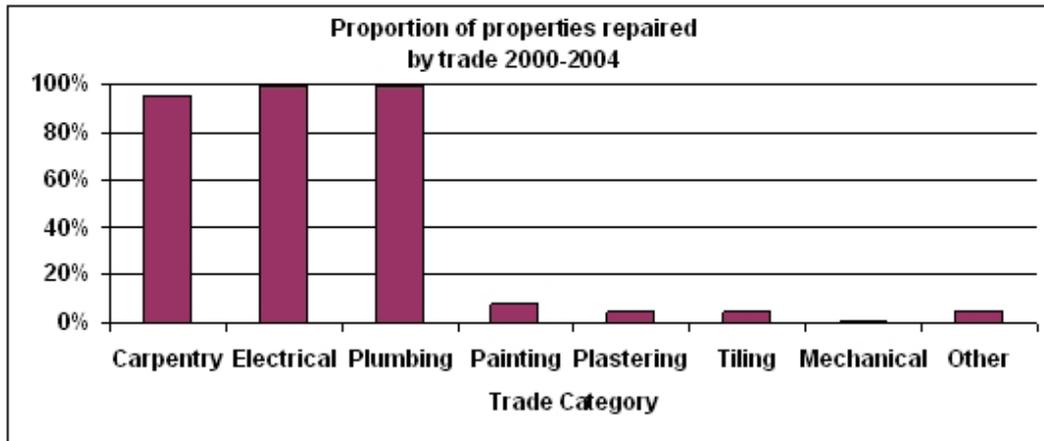


Figure 12: Proportion of properties repaired by trade (2000–2004)

When looking at the last year in particular it is apparent there is a considerable number of maintenance calls for these three key areas and, overall, nearly all properties received some form of maintenance in the last year (Figure 13).

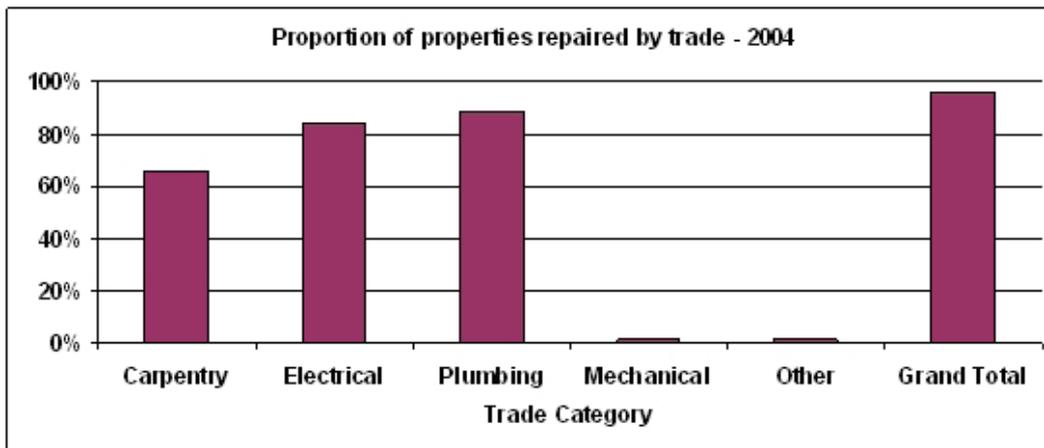


Figure 13: Proportion of properties maintained by trade (2004)

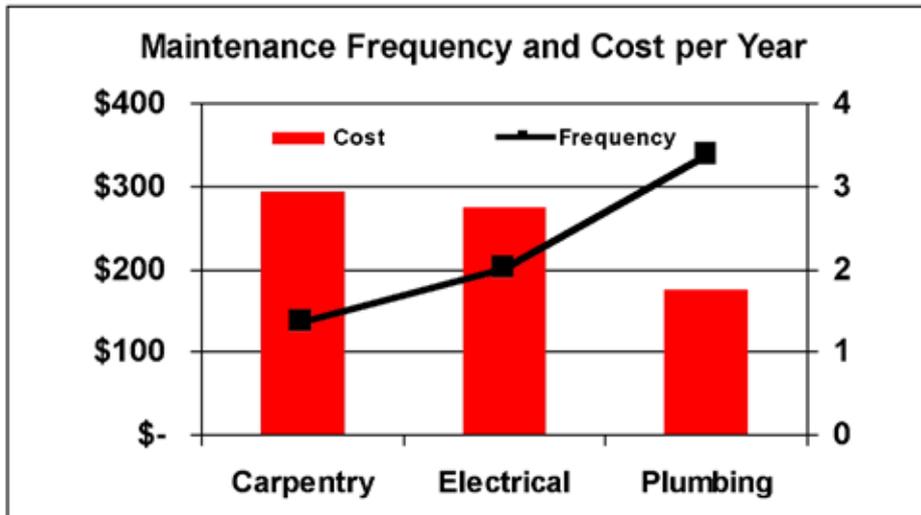


Figure 14: Average amount expended per property by trade (2004)

In 2004 each property received 1.5 carpentry visits at an average cost of \$300, two electrical visits at an average cost of \$280 and 3.5 plumbing visits at an average cost of \$180, giving a total of 6.7 visits per property in 2004 at an average cost of approximately \$1515 per property (Figure 14).

#### Comparison of data

By comparison, Figure 15 below shows the proportion of properties maintained by trade for both the settlement organisation and public housing. It is clear that a greater proportion of settlement properties require maintenance annually than public housing.

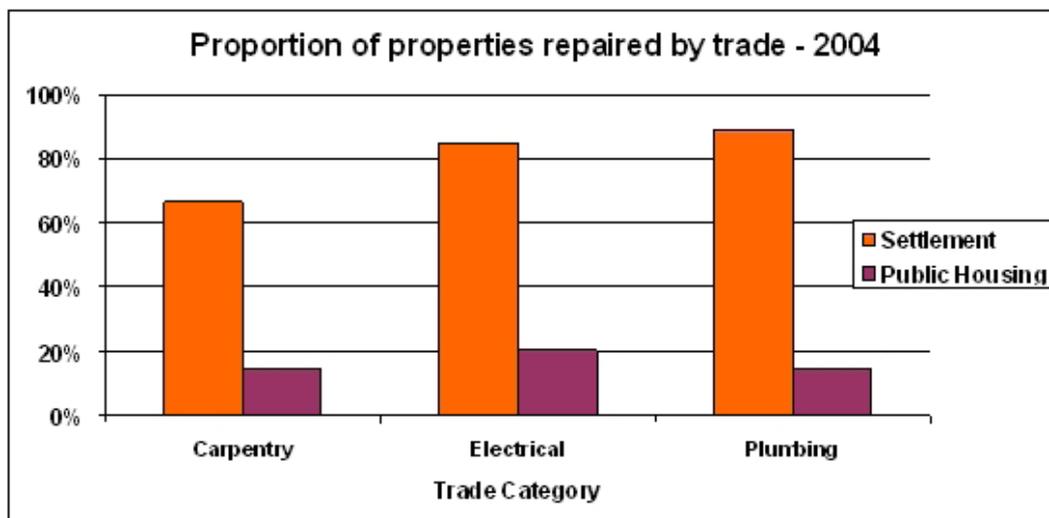


Figure 15: Comparison of settlement and NT public housing of properties maintained by trade (2004)

Similarly, a comparison of the number of visits and cost per visit indicates there is scope for change (Figure 16). Overall, both property managers expended approximately \$1500 per year on their properties. However, there were approximately 6.7 visits per property per year for the settlement organisation, compared with 3 visits per property per year for the public housing.

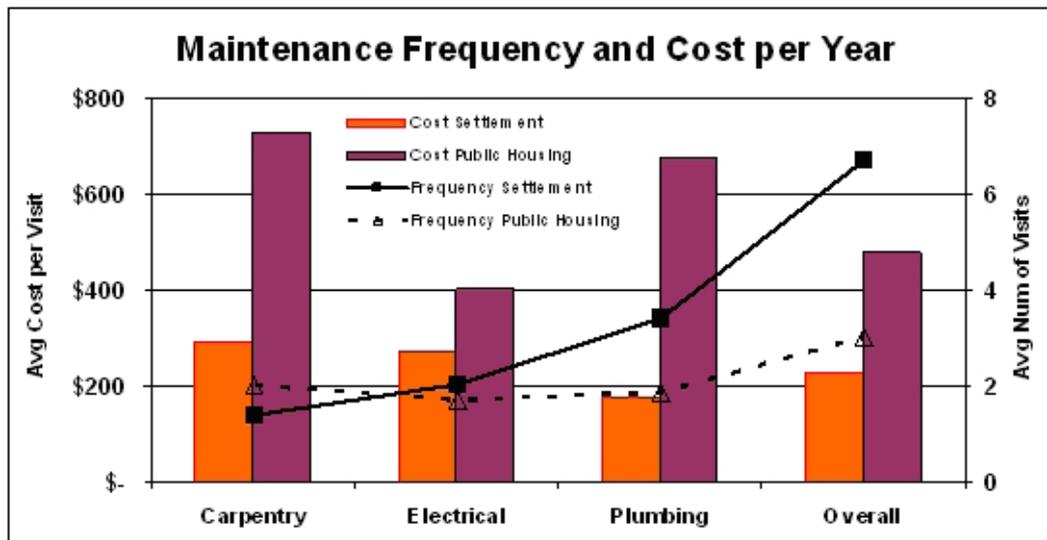


Figure 16: Comparison of settlement and public housing maintenance visit cost and frequency

### Data usefulness

Over the course of this research, considerable effort has been expended in gathering existing data. There have been problems in extracting appropriate data from the relevant funding agencies. While all the data on maintenance costs in selected settlements and housing agencies is informative, the quality is not enough to support the development of the relational algorithms necessary for effective model design and programming. Consequently, there is some doubt as to the veracity of any current model to estimate housing lifecycle performance to meet demand.

This finding affirms the need to establish a dedicated second phase in future research to hone what data needs to be collected, its timing and how it is to be compiled so as to assure the effective development of longer-term decision tools. This data review has identified a number of issues for consideration.

### Data quality

There is a need to standardise the coding for consistency, possibly through the introduction of a limited drop-down list for coding which is consistent across the various management and administrative boundaries.

Field names for the CIAS data provided were not the same as those in the general codes table, making interpretation difficult. Consistency is crucial for quality data.

The CIAS survey data table captures data from a number of sources including settlement property and demographics tables in an attempt to ascertain the completeness of the surveying activities of the period and the data consistency. Of the settlements surveyed, 147 (about one in three) showed inconsistencies regarding the existence of properties. That is, properties were surveyed that do not exist in the settlements' dataset. Random assessment of the data indicated the data is inconsistent in terms of properties registered and surveyed. Settlement housing survey data has enormous potential and could support a strategic management application if the issue of data quality and completeness was rectified.

### *Maintenance activities*

Analysis of maintenance activities carried out by the settlement organisation shows only responsive maintenance activities are being completed. Given maintenance that can reasonably be afforded is being carried out, there is a need for a decision-making framework for optimal operation if the funding levels are to remain the same.

For maintenance activities during the period covered by the data, almost all properties received attention for carpentry, electrical and plumbing. In 2004 each property received a total of 6.7 visits at an average cost of approximately \$1515 per property. Nearly every property in the portfolio received some maintenance during the previous 12-month period.

A comparison of the number of visits and cost per visit indicates there is scope for improvement. Overall both property managers expended approximately \$1500 per year on their properties. However, there were only three visits per property per year for the public housing, compared with 6.7 visits per property for the settlement-managed housing.

### *Data on funding for maintenance*

In the Northern Territory, a grant of \$1700 per annum is available for repairs and maintenance per house. While it is unclear how this amount was derived, it is conditional on the properties being in reasonable condition and having access to the services. Missing services result in a deduction of funds. Also available is a grant of \$40 000 or \$500 per property (whichever is lowest) for management of the maintenance.

Also available for maintenance activities is the annual rent for a property, calculated at \$1560, with a maximum for a post-June 1998 house of \$2600, providing the property offers full functionality. The reality may be very different: rent may be as low as \$20 per fortnight, or even not collected at all. Thus when housing is deemed to be in poor condition with services elements not connected, a property may only be eligible for a repairs and maintenance budget as low as \$100 per annum.

Total maintenance funding for a functional house is \$3260 for pre-July 1998 properties and up to \$4300 for post-June 1998 (Table 5).

Table 5: Funding for settlement housing

\$/dwelling/year	Pre 1998		Post 1998	
	Max \$	Min \$	Max \$	Min \$
Rent	1560	0	2600	0
Grant	1700	100	1700	100
Total	3260	100	4300	100

## Development of new model condition indices

### Key areas for Lifecycle Model development

The following questions would be typical of those responsible for managing any housing portfolio, and thus have been used to inform the development of a Lifecycles model and its condition indices.

### *Investment and funding expenditure*

- Which properties require resources?
- What is the benefit of providing the resources?
- Is there a better alternative?

### *Maintenance strategy*

- Strategic planning – What components perform best? How can we use this information?
- Tactical planning – How can the resources best be used?
- Operational maintenance planning – Which properties need what work?

### *Review of maintenance standards*

- What maintenance items have been deferred?
- What is the impact of deferred maintenance?
- How are service providers performing?

### *Stock review*

- What properties in the portfolio need to be reviewed?
- How do the properties being reviewed compare?
- How can the condition of properties be accounted for?

### *Property standards*

- What standards should be applied?
- What is the cost of meeting the standards?

### *Client services*

- How can a property be assessed to determine if it is tenatable?
- Can it be quickly and easily referred to for assessing tenant complaints?

### *Financial services*

- How can the model enable a refined assessment of the remaining useful life of the asset?
- Can the model provide data for property valuation?
- Can the model assess the long-term suitability of a property within the portfolio?
- Can the model support an annual review of market rents?

### *Housing policy and research*

- How can the model assist in the evaluation of strategic priorities?
- How can the model support coordinated strategic policy?
- How can the model contribute to the corporate planning and budget cycle?

## Prioritising maintenance work

Cost-critical lifecycle events are important to identify, and this can be assisted through prioritisation, as there are many regularly occurring events requiring attention in the daily life of remote settlements. A condition index can contribute to more rational prioritisation. There is substantial literature available on this issue. Shen (1999) provides a useful method of setting priorities by considering the need for maintenance and the risk of not undertaking maintenance. The prioritisation of asset maintenance can be determined using a four-quadrant matrix reflecting the need and risk criteria ranging from critical need to not critical and high risk to low risk. Those actions that are both high risk and critical need should receive the highest priority while those on the other end of the scale can be deferred. Those actions that fall in the other two quadrants require assessment for resource allocation. It may be that the specific elements of the dwellings could be categorised into areas and the Performance Condition Index (PCI) tool could provide feedback on the effectiveness of maintenance programs.

According to Shen (1999), both hard and soft dimensions should be taken into consideration. The effectiveness of the maintenance can be assessed via a two dimensional value-for-money matrix. On one axis is the economic worth of the property and on the other are the users' perceptions. Those actions that rate highly in both areas indicate effective actions while those that score low for both indicate low value for money actions and give improvement projects, while the balance require monitoring for areas to improve.

### Maintenance program delivery models

Various service delivery models should be considered in an attempt to minimise cost and maximise efficiency of service delivery. Two potential models include a matrix model and a radial model. With the matrix model, the state, territory or jurisdiction area is overlaid with a geometric grid; for each grid there is a qualified maintenance team with minimal distance to travel to the portfolio. Each grid size would be population/activity weighted. The radial model is based on a qualified maintenance team responsible for a region radiating from a larger centre of population. The radial distance would be calculated as a function of population and accessibility.

Conceptually, qualified service delivery teams are assigned areas to service according to one of the above model approaches with particular attention given to supporting and developing local capacity. Each local settlement would be charged with the responsibility of responding to unplanned maintenance, while planned activities would be completed by the regional teams. These teams would also have a role in capacity building within the settlements. The role of refurbishing would be the responsibility of the state authority, as is new construction.

### Recommended condition index

It is recommended that a cost-based condition index (based on the HSCI) be developed, with a supplementary function-based index. This approach will provide the basis for planning and prioritising maintenance activities based on:

- risk of failure
- consequence of failure
- impact on tenants
- maximising resources.

The resulting indices will be:

- a quantifiable measure of the current state of a dwelling/housing portfolio as indicated by the work necessary to bring dwellings up to the required standard within a defined period
- easily calculated
- independent of inflation
- a quantitative measure of condition as a single number
- interpretable
- applicable at various levels of details in a similar manner
- sensitive to maintenance/capital expenditure
- accommodating of changes in standards and regulations
- repeatable
- comparable over time.

With regular updating of the base data, these indices can be kept current for continuous assessment of changes in condition of the stock.

# Software tool development

## Status

This scoping stage included the testing of conventional software used to schedule the maintenance of public housing in urban, normally coastal, regions of Australia. Modellers designed a working software package to demonstrate the concept of how the above factors work in the software’s algorithm, in spite of the lack of data and detailed user evaluation. Lack of real desert settlement data was substituted with data from the mainstream public housing experience to determine what the proposed model may look like. Achieving ‘workability’ of the model is a key step before the next phase of data gathering, in the next stage of research. A full working prototype is still some way off, and should be developed in the next stage of research.

## Housing quality impact factors

The following ‘mind map’ schematic sketches the kind of factors and their possible relationships explored in the design of the software decision tool (Figure 17). This has been derived from the reviews of asset management theory, existing models, international experience, available data and contextual factors emerging from consultations with communities. This map represents how the social and physical context of remote desert settlements informs the development of the lifecycle tool.



Figure 17: Concept model of the Lifecycle software model under development  
Note: Showing the multi-factor influences

## Graphic User Interface and other features

The software tool is made accessible to the user through a familiar, easy-to-use, graphic user interface (GUI). Output includes bar charts that display the benchmark, the average, the expected (for the user), and the actual. The choice of programming language is an issue that can be considered during the next phase of prototype development. The existing application is written in Java, as this language is not confined to a specific platform and has the potential to allow users with older computers and operating systems to run the application at minimal levels of functionality. To also contribute to high levels of usability, the software can use minimal data to limit data collection activities, if necessary or if data collection is difficult and it will be developed to enable remote support with no licensing for the application or database.

## Using the software

As part of the proof-of-concept approach, the software was developed sufficiently to demonstrate the ‘workability’ of the asset management approach embodied in the software. This section shows the process for using the software, by progressing through a series of screenshots of different tables.

The first step is to understand the components of the database. Figure 18 maps the relationships between different aspects of the SQL database currently supporting the application. There is no data behind this application at this point; it requires both SQL Server 2000 and the database to be on the user’s computer. Open-source database applications, which can connect to SQL (or any other database console) but are wholly contained within the application, are available; this set-up results in an application being capable of being used on any computer.

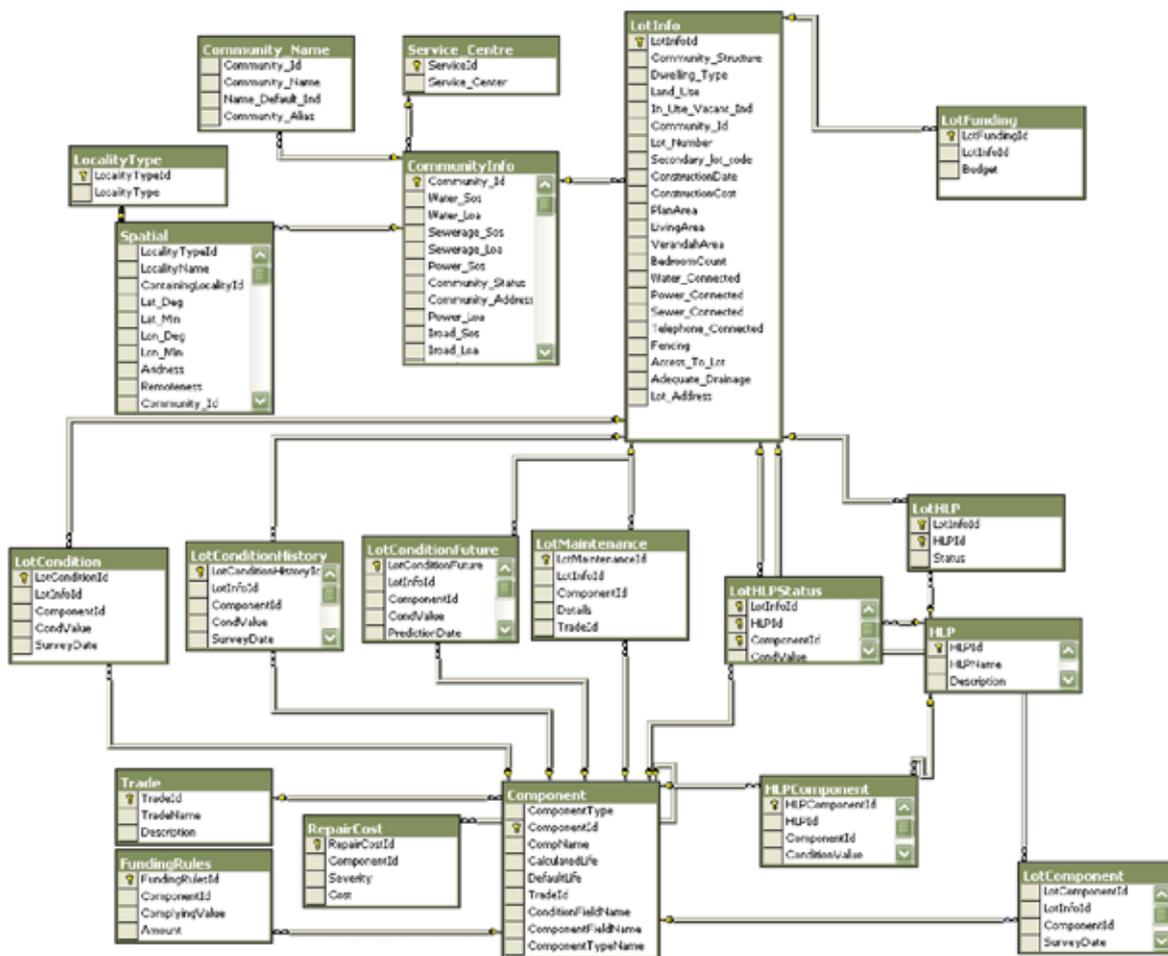


Figure 18: Database diagram for the SQL database currently supporting the application

Once the application is run the user creates an assessment (Figure 19). The screenshots that follow focus on the kitchen.



Figure 19: Entry point for the assessment

The user then selects the properties of interest via a hierarchical tree (Figure 20).

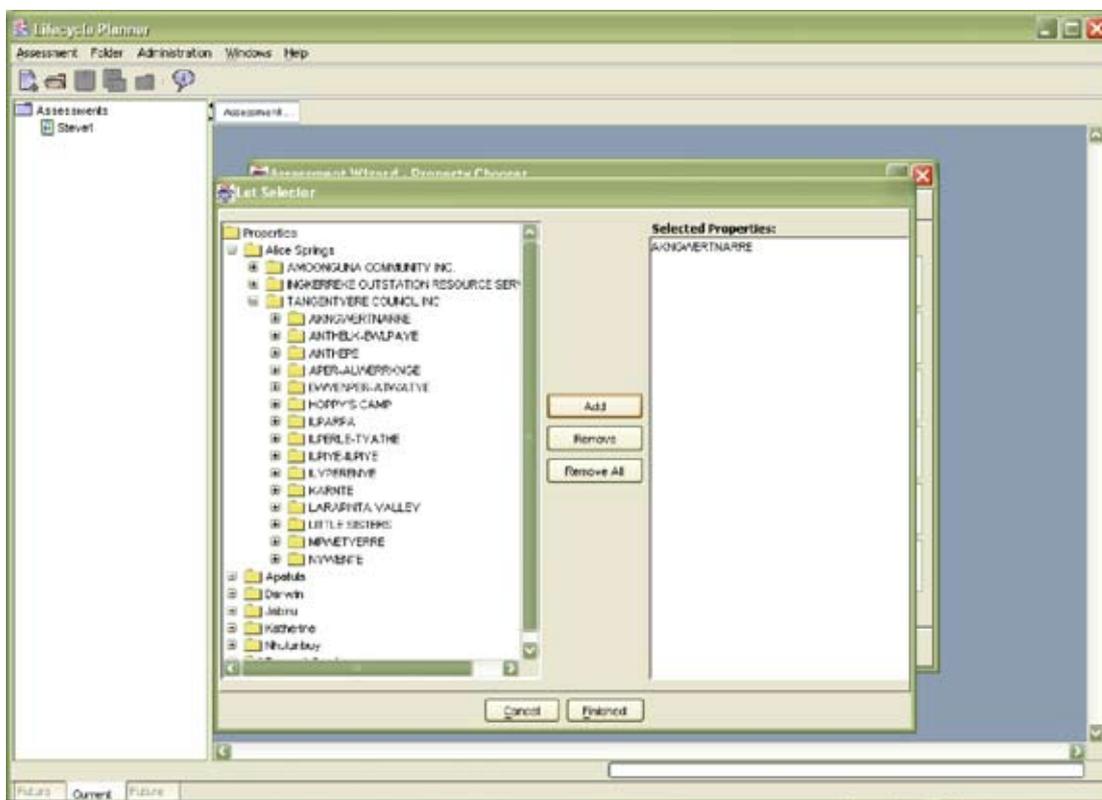


Figure 20: Hierarchical tree

Likewise, other dimensions such as construction type, bed count, year built, repair and component, can be qualified to result in the subset of properties to be considered in this assessment. These dimensions are communicated in a tree diagram, enabling simple selection. The selection is reported in the wizard shell, informing the user of the selected categories. The next phase is to select the output category required. It is likely that some of the categories will result in considerable calculation, should the selection be extensive, particularly where the computing hardware is older. For this reason the user can select the output of interest at this time and modify the selection in the future if required.

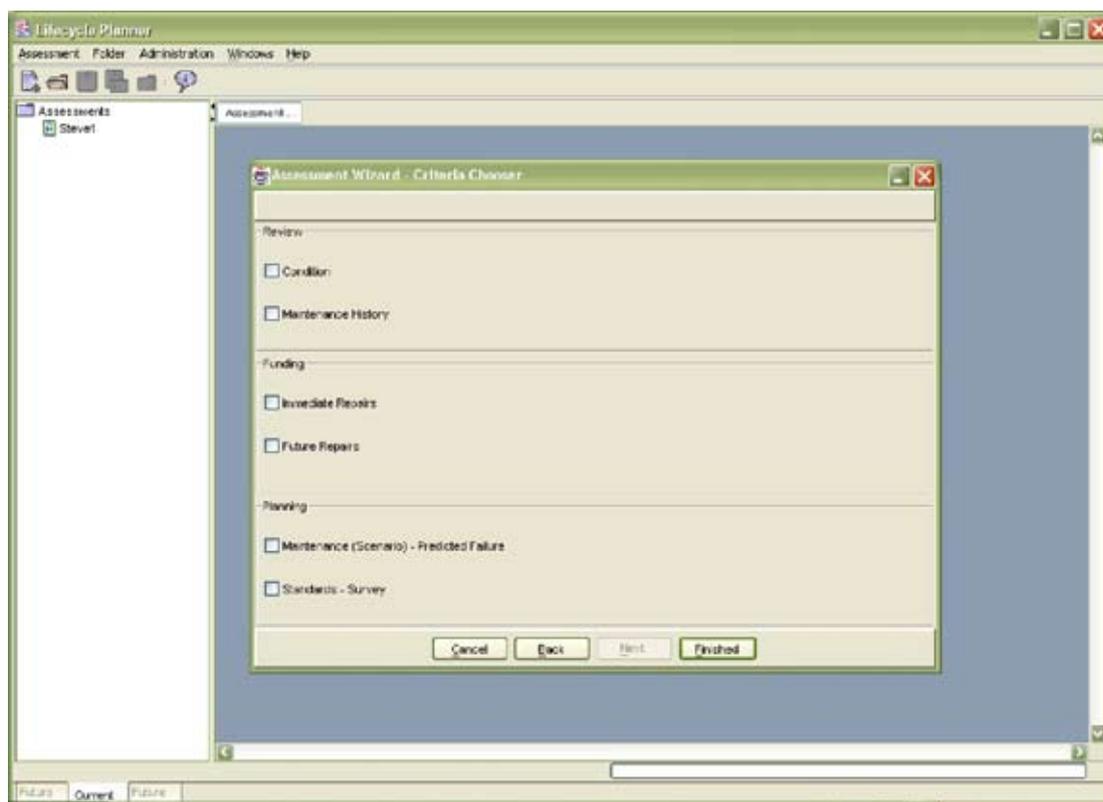


Figure 21: Output categories

The output categories (Figure 21) at this time are:

- Review
  - Condition
  - Maintenance history
- Funding
  - Immediate repairs
  - Future repairs
- Planning
  - Maintenance (Scenario) – Predicted failure
  - Standards.

This list would be increased to enable scenario functionality. Once processed, the application returns a window displaying the selection criteria, headed with a series of tabs enabling access to the various outputs selected (Figure 22).

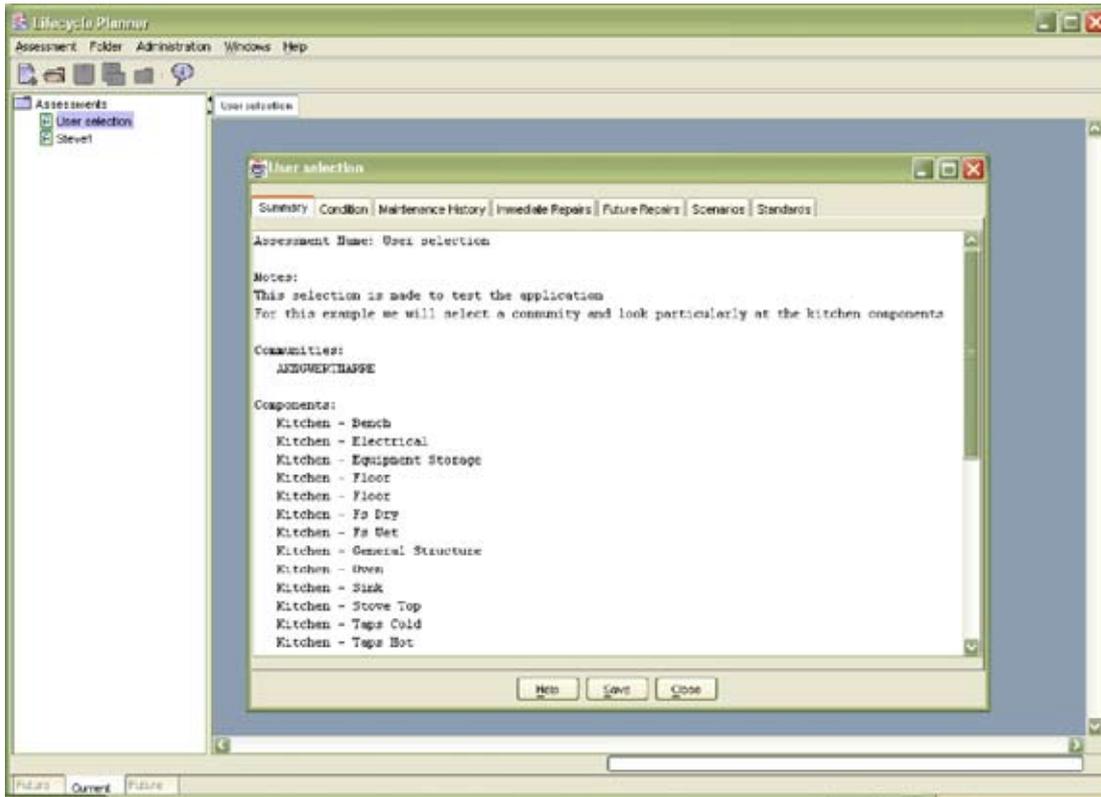


Figure 22: Output selected

The condition tab displays the condition of the components selected and provides detail of the number in each of the condition levels (Figure 23). By clicking on any of the chart bars the application shows a distribution of the selected condition level.

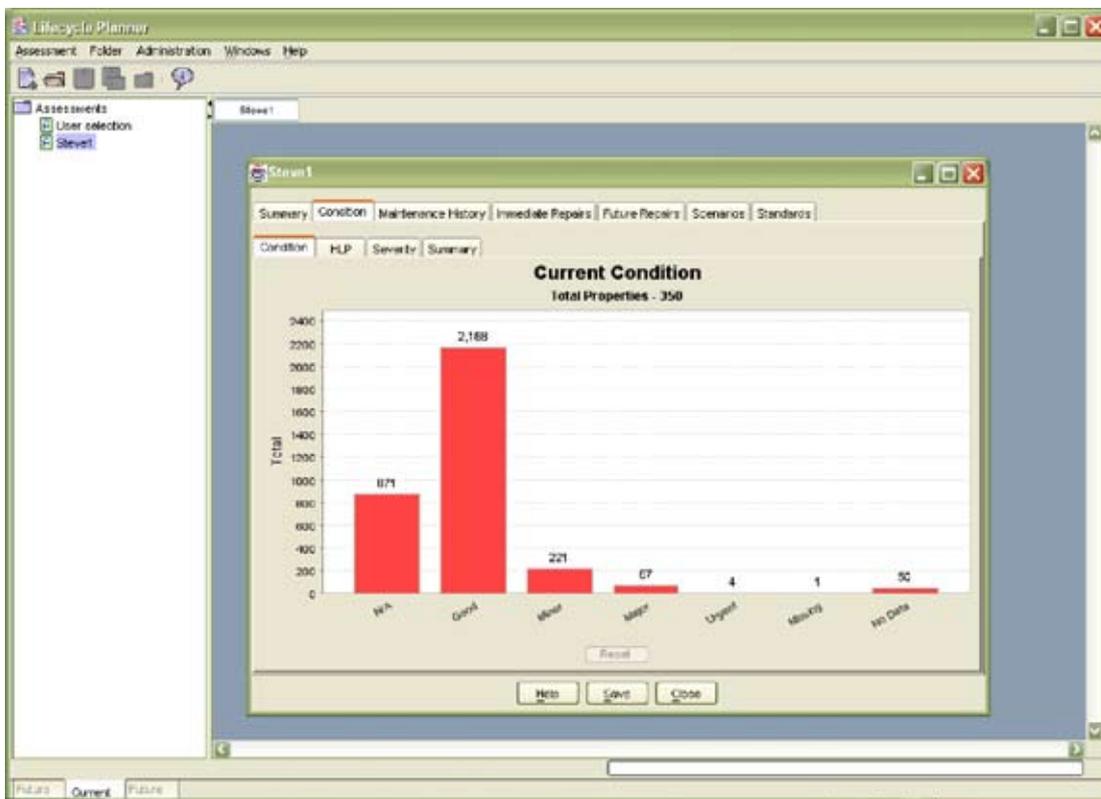


Figure 23: Condition tab

Thus the user can determine where urgent attention is required and which components are performing well or poorly (Figure 24).

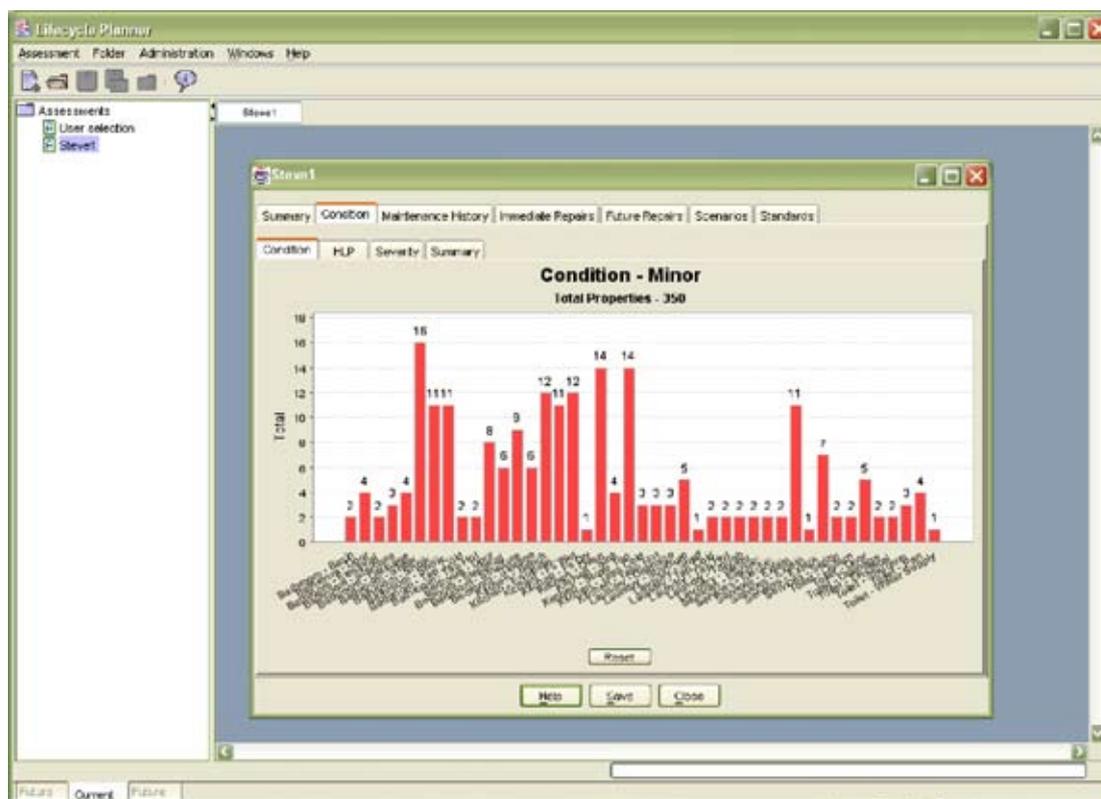


Figure 24: Component assessment

From this chart it can be seen that of the 350 properties selected from this assessment, 14 require new stovetops and ovens. By clicking on these columns the information on items needing repair can be identified. The application can provide insights into any spatial correlation to maintenance. For example, where there has been a cultural event and a large temporary shift in the population, there would be an expectation that extra use would result in higher maintenance demand. This application can aid identification and service planning after such events.

The immediate repairs tab (Figure 25) displays charts showing investigative functionality:

- which components?
- how many?
- which items require urgent attention?

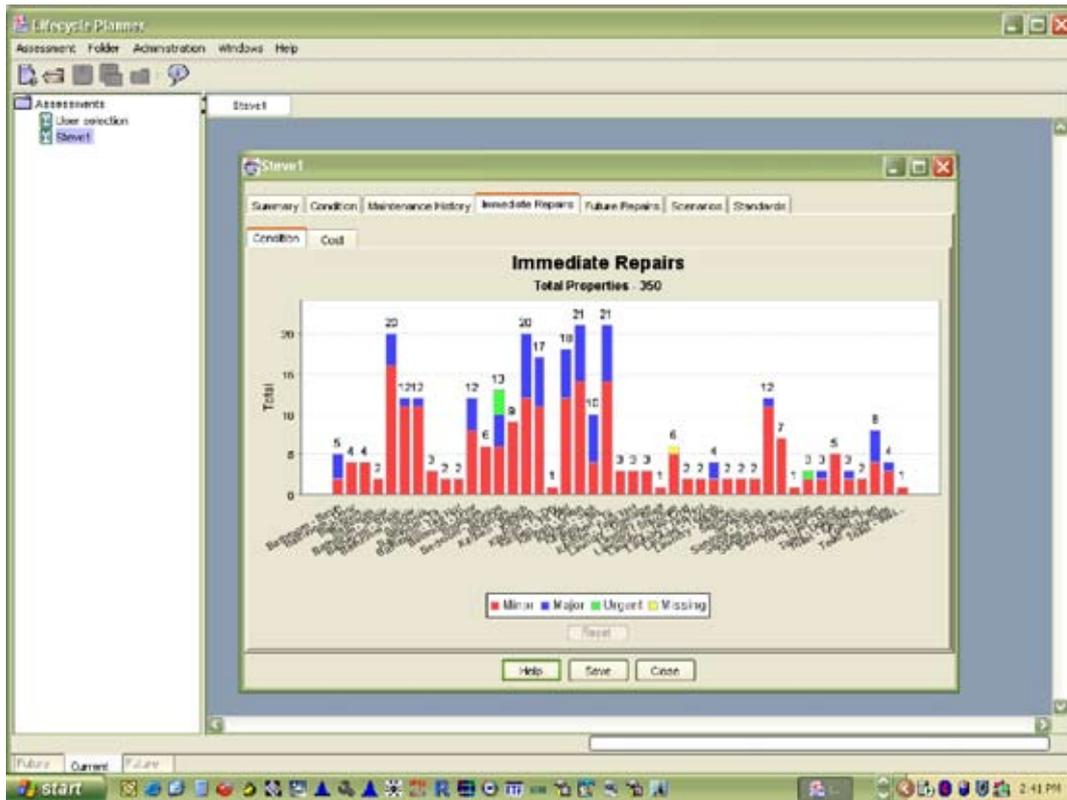


Figure 25: Investigative functionality: Immediate repairs

This investigative functionality can be extended to provide budget estimates for the cost of maintenance (Figure 26).

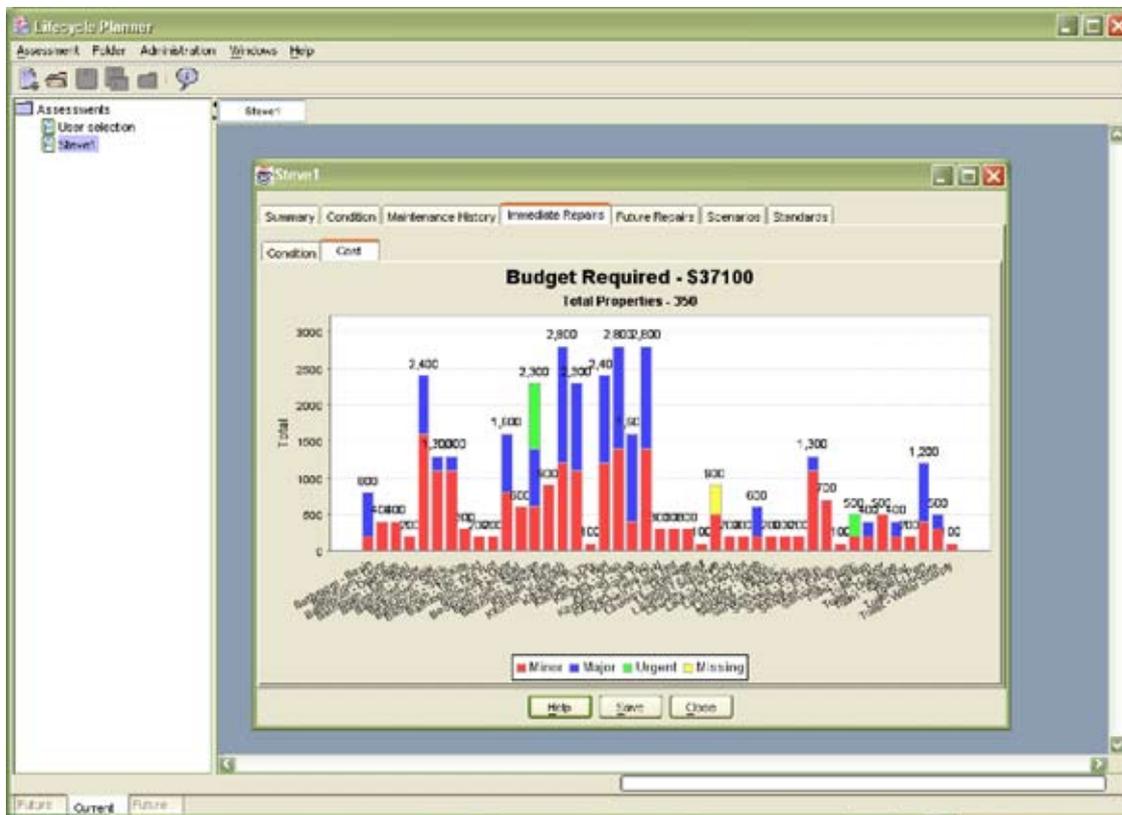


Figure 26: Budgeting for identified repairs



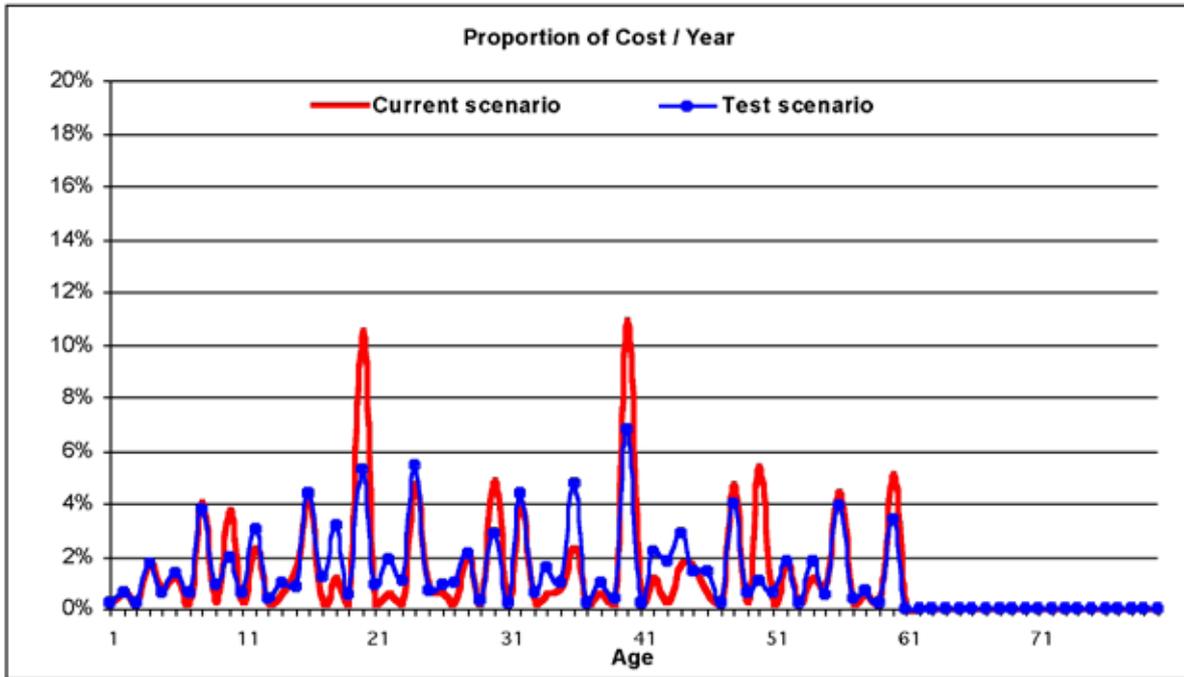


Figure 29: Future cost scenario capability

Development of an objective index could also inform managers and users of properties that are not performing relative to the rest of the portfolio. It could also aid in the planning process (Figure 30).

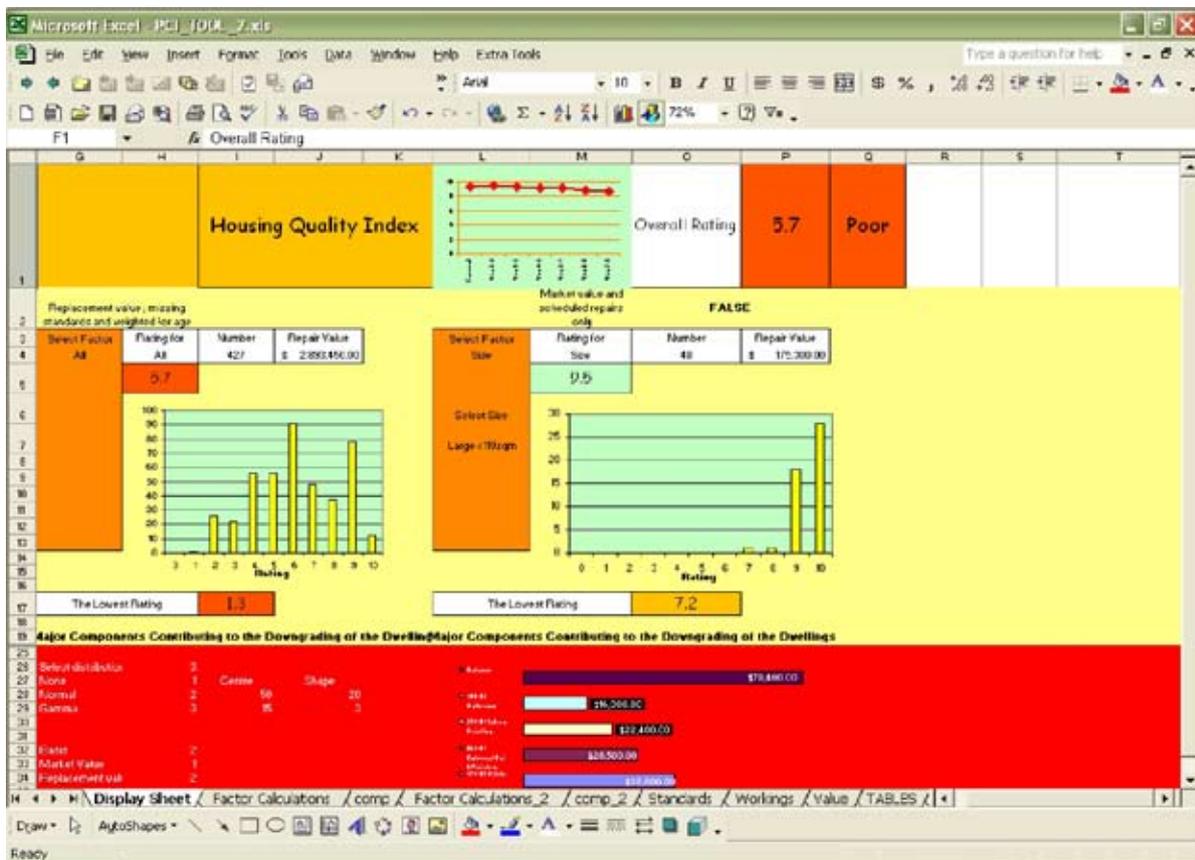


Figure 30: Summary page with housing quality index

It also means that efficient communication and cooperation between housing authorities may be hindered by different priorities. In the researchers' opinion, the main feature of any prioritisation tool should be to allow the user to rank building component replacement based on a risk ranking approach, using the predicted failure performance and the social (e.g. health risks), environmental (e.g. flooding and loss of housing) and financial consequences (i.e. cost of repair and replacement) of building component failure.

## Summary

The development of appropriate lifecycle tools is a key aspect in improving future prospects for sustainable livelihoods in the desert. In this part of the report, the following was reviewed:

- theory and concepts in asset management
- existing lifecycle models and their condition indices, both in Australia and internationally
- availability of quality of remote desert settlement housing data.

This part of the report has also demonstrated the current state of development of a lifecycle tool. Areas identified as benefiting from the development of an asset management tool include:

- investment and funding expenditure
- identification of which properties require resources
- identification of the benefit of providing resources
- identification of better alternatives.

The review of asset management strategies, lifecycle costing and modelling related to the construction, maintenance and repair of housing revealed a lack of literature. The information presented did, however, provide some background on issues related to construction, maintenance and repair of Aboriginal housing in Canada and in the USA. In each case, the situation described reflected aspects of the situation faced in Australia. Key commonalities are the severity of conditions, inappropriate design, housing age, over-crowding, lack of local capacity and resources, and inadequate funds.

In Australia, the AIHW study (Sheehan, Jenkins & Phillips 2001) collected available data to construct a model to inform decision-making for funds allocation between construction of dwellings and their maintenance. It was aimed at administrators and communities to enable understanding of the impact of resource allocation decisions in any one year on the levels and condition of stock in subsequent years. The conclusions clearly identify that there are many dwelling use factors which impact on longevity, but about which little or no data exists. Similarly, the shortcomings of using city-based cost data are clearly stated, and the need for better data becomes a recurring theme throughout.

The SGS/Urban Resources study (2000) had a broad range of objectives, of which a model for target setting was only a minor part. The study concluded that high occupancy levels, cultural differences, high costs and lower rent lead to higher maintenance costs for Aboriginal housing. The study also stated that because of incomplete data, the model can only illustrate general principles; however, with better data it could be used to calculate expected stock levels over time, for the whole housing stock, or for particular parts of the stock, or for individual housing organisations.

The reviews consistently concluded that the lack of adequate data limited the potential for development of successful maintenance strategies, and the lack of adequate funding and resources was significant. Flood (2002b) shows there are significant decisions yet to be made, particularly the choice of quantity versus quality under funding regimes.

To identify cost-critical lifecycle events, one of the tasks completed was to identify the combination of factors impacting on housing durability and how the effect of these factors can be minimised. A range of factors expected to have an effect on the housing quality was identified, and a risk matrix developed to quantify the possible impact. For each of the factors, issues, importance, impact and likelihood were hypothesised; however, systematic assessment would enable ranking of the impacting factors and therefore enable a reduction strategy to be developed and implemented. This data could also be used within an application to prepare forecasting scenarios leading to information for strategic management decisions.

Also discussed were model(s) to underpin an assessment tool which can provide support for management decisions for properties and be extended to provide results for the communities up to portfolio level as it currently stands, but be flexible in enabling changes to the portfolio composition to be input in order to test the impact. Discussion of impact factors and development requirements followed, providing the reader with a guide to developing an application.

Data was obtained from the Northern Territory Government, the Federal Government and a Central Australian settlement organisation. This data was analysed for appropriateness, to determine data gaps, and to use in the prototyping of lifecycle software. A number of issues were identified in this analysis. These are:

- Settlement housing survey data has enormous potential and could support a strategic management application if the issue of data quality and completeness was rectified.
- Consistency is crucial for quality data: there is a need to standardise the coding for consistency, possibly through introduction of a limited drop-down list for coding which is consistent across the various management and administrative boundaries.
- Random assessment of the data indicated the data is inconsistent in terms of properties registered and actual properties surveyed.
- Analysis of the maintenance activities of settlements shows only responsive maintenance activities are being completed.

There is a need for a decision-making framework for optimal housing management, especially if the maintenance funding levels remain the same.

In settlement housing in the Northern Territory, maintenance activity data over 2004 showed that almost all properties received attention for carpentry, electrical and plumbing. Each property received on average 6.7 visits at an average cost of approximately \$1515 per property. Nearly every property in the portfolio received some maintenance during the previous 12-month period.

In the public housing sector, there was approximately \$9 million (\$1.8 million/year) in maintenance expenditure, on about 1850 of the 1916 properties, with a planned/unplanned maintenance expenditure ratio of 30:70.

A comparison of the number of visits and cost per visit indicates there is scope for improvement. Overall both property managers expended approximately \$1500 per year on their properties. However, there were only three visits per property per year for the public housing compared with 6.7 visits per property for the settlement data.

During the data period, the annual potential rent for a property was calculated at \$1560, with a maximum for a post-June 1998 house of \$2600, providing the properties offered full functionality.

Rent is often not collected, with significant impact on capacity to maintain housing and to attract housing funds.

Total maintenance funding to be used for maintenance activities for a functional house is therefore \$3260 for pre-July 1998 properties and up to \$4300 for post-June 1998.

The CIAS survey data for 2004 had population count for the settlements surveyed of approximately 52000 and covered 6000 properties, indicating there was on average 8–9 people per property; this confirms modelling should accommodate higher than average usage.

Issues of other firm costs such as human resources, occupational health and safety, training, finance, administration and so on have not been explored and clearly are significant costs to carry.

Generally, the data is collected to meet reporting requirements and has limited use for other management activities. However, with little extra effort, suitable data should be able to be collected, and by supplementing this data with contextual and resourcing inputs (such as user feedback via housing stories as illustrated in **Part 3: The Housing Stories Approach to Evaluation**), valuable information can be generated to systematically support management decisions.

Data should be used for both maintenance planning and prioritisation, and coupled with asset management planning models, increasing scope for the prediction of maintenance expenditure. Decisions on proactive versus reactive actions can be justified and overall housing costs minimised. Planning models should allow housing authorities to model long-term operational strategies and provide impact assessment of decisions. Prioritisation is a balance between needs and risk and through the introduction of an assessment matrix, the identification of suitable areas for fund allocation can be generated. Clearly a decision on funding allocation needs to be balanced with information on the clients' needs and the property condition.

The delivery of maintenance planning was discussed, and a range of solutions offered, but in essence the solutions highlighted the need to roll out plans in the spatial dimension that was most sensible in terms of local and regional capacity.

Intimate knowledge of the condition of the property profiles at the various stages of their lifecycles will lead to improved portfolio management strategies and policies. Adopting a consistent approach across the organisations will lead to costs savings and increase the opportunity to share resources.

Current data available can be used in limited way to support a tool. Over time the database can be populated once data collection methodologies have been designed. Data relating to completed repairs can be entered into the database to provide the information required for strategic planning.

By applying a lifecycles model using the background, theoretical basis and proof-of-concept software, the following benefits may accrue for funding agencies, housing managers and settlements:

- extended lifecycles of desert housing
- optimised maintenance activity
- improved rental income potential
- improved housing stock value
- managed replacement program
- determining of optimal intervention strategies
- enabling of forward business planning
- improved risk management processes.

The research to date has demonstrated the proof-of-concept, but further work is needed in the areas identified before a Lifecycles tool can be made available.

## Part 3: The Housing Stories approach to evaluation

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A significant outcome of the scoping research was the proposal and validation of a process designed to express local values of housing as part of the feedback aspect of the housing systems model identified in **Conceptual Framework**. This process was developed and a framework proposed for implementation in future research.

In future housing-for-livelihood research, it is proposed that Participatory Monitoring and Evaluation (PME) processes be applied: a suite of settlement-level approaches enabling people to monitor and evaluate the programs and processes which affect their lives according to their own values and priorities, not the values and priorities of the outside funding agencies and their consultants. Further, future participatory research actions should provide a service to participating settlements in exchange for access and information.

Housing and infrastructure in Aboriginal Australia is periodically evaluated for performance against a range of benchmarks and desired outcomes. Such evaluations are driven by the needs of funding agencies and their interpretation of the needs of individuals in remote settlements. They take no account of the imposed embedded values and cultures of the process of housing and infrastructure delivery.

Conventional housing and infrastructure evaluations are very clear about the limitations of direct, short-timeframe survey methods. Consequently, a long-term process is proposed, embedded at the settlement level, allowing time for the deeper meanings of housing to emerge: in essence, to gain answers to the research questions without asking questions.

The PME approach is proposed because it increases the chances of obtaining a fuller picture of the value people place on their housing; their usage behaviours; and critical events that impact on the life of housing. A suite of specific participatory research and analysis techniques, that is, a participatory methods 'tool box', is suitable for use. The participatory process can be responsive so that methods can evolve in ways sympathetic to priorities of local people; such a process allows space for the development of research techniques by local people.

### Housing and infrastructure evaluations

Housing and infrastructure in Aboriginal Australia is periodically evaluated for performance against a range of benchmarks and desired outcomes. Such evaluations are usually focused on financial accountability: Was the money spent on the agreed number of houses? Was it spent within agreed timeframes? Were required reports submitted on time? Was the product delivered according to specification?

Such evaluations are driven by the needs of funding agencies and their interpretation of the needs of individuals in remote settlements. While at that level of system hierarchy such a viewpoint is valid, it begs the question of how valid it is from the point of view of settlement people. It takes no account of the imposed embedded values and cultures of the process of housing and infrastructure delivery.

This section of the report briefly looks at some recent housing and infrastructure evaluation programs and summarises their broad approaches.

## National Aboriginal Health Strategy (NAHS) Evaluation

This *Performance Audit of the National Aboriginal Health Strategy* (NAHS) was carried out by the Australian National Audit Office. The objective of the audit was to:

*...form an opinion on ATSIC's management of the National Aboriginal Health Strategy program in providing housing and related infrastructure to Aboriginal and Torres Strait Islander communities and to identify any areas where program administration could be improved* (ANAO 1999 p. 12).

There was scope to focus on the performance of project managers, on a 'purchaser-provider' model and on the relationship of private, public and settlement sectors.

The audit involved interviews with ATSIC staff at all levels, and with staff of government agencies in Western Australia and the Northern Territory. Private sector participants (such as program and program managers) and settlement representatives were also interviewed. The report does not mention the methodology used in interviewing settlement representatives.

Six construction projects across Western Australia, the Northern Territory and New South Wales were visited. As such, the audit only addressed the construction phase, with only 'limited reference to their operation and maintenance'. (ANAO1999, p. 12)

It is evident that this evaluation of NAHS in 1999 was focused on the processes of delivery with little or no concern of the legacy of that delivery, in terms of quality of life for users of the technology and the capacity to operate and maintain what has been delivered so efficiently. This is in spite of the fact that the NAHS program requires project managers to participate in capacity development of local people for management of housing.

There was no scope in the report to evaluate settlement response to performance of the new technology and to their perceptions of their capacity to maintain it.

## Post-occupancy evaluation of IHANT and NAHS housing

This evaluation, as discussed in the report, *Living Spaces: An Evaluation of Housing in Remote Aboriginal Communities* (Fletcher & Bridgman 2000a) was conducted by the Architect's Studio as commissioned by the Aboriginal and Torres Strait Islander Commission (ATSIC) and the Indigenous Housing Authority of the Northern Territory (IHANT) in 2000. The objective of the report was 'to evaluate the success or otherwise of houses designed and constructed for Aboriginal people in remote communities in recent years' (Fletcher & Bridgman 2000a p. 1):

This report is arguably the best housing evaluation report to date in terms of the approach taken, particularly as a post-occupancy evaluation. It strongly identifies key issues in housing design that appeared significant to this research.

The methodology involved identification of houses meeting certain criteria based on age, occupancy, delivery process and willingness of occupants to participate in the survey. User satisfaction was one of four evaluation factors. Occupants were surveyed using a formal questionnaire after having been shown a 'story page' explaining why the researchers were calling on them.

The research methodology identified the importance of social, behavioural and cultural issues, but focused on direct questioning and observation at the time of interviews. The questions were not of an open nature, mostly requiring yes or no answers, which can be problematic. For space issues (in any kind of housing), for example, there is never enough space for certain activities. So asking if there is enough space will almost always elicit an answer of ‘no’.

There was scope for two interviews: a ‘Householder’s Primary Interview’ and a ‘Householder’s Secondary Interview’ with ‘the most cooperative and informative householders’ (Fletcher & Bridgman 2000a p. 62). There were, in total, 33 primary interviews and an unspecified number of secondary interviews. The individual settlement reports made no mention of the secondary interviews: either none happened or they followed up the questions from the first interview in more detail. However, the approach to surveying has a certain ‘hit and run’ quality about it that in itself may have helped shape the general householder response to the process. This raises questions as to whether there was much cooperation from householders; given the small number of householders surveyed, it is possible that cooperation was not so forthcoming.

Such methodological problems were identified, and proved to be significant in the final outcomes (Fletcher & Bridgman 2000a p. 62). Problems included:

- absentee households
- absentee householder(s)
- householder(s) reluctant to participate in interview
- reluctance to allow internal access to house
- reluctance to allow internal access to bedrooms, bathroom, etc.
- total lack of critical views about the house (could be for a range of reasons)
- reaction to intrusive nature of POE, resulting in general lack of cooperation
- householders pre-occupied with other life crisis (death, birth, conflicts, etc.)
- reluctance to be interviewed or to provide detailed information to a strange non-Aboriginal person
- reluctance to be interviewed or to provide detailed information to an interviewer of ‘inappropriate’ gender
- householder cannot talk English (or at least understandable English), and prefers to talk in an Aboriginal language.

Another issue in the report concerns the overall satisfaction ratings of the householders with the houses surveyed (Fletcher & Bridgman 2000, p. 96): ‘Aboriginal respondents, despite some reservations, tended to be unanimous in their praise of the new houses.’

Yet, the section of the report raising issues requiring consideration in house design are so extensive, and in places quite complex, that it contrasts starkly with the satisfaction ratings. This indicates that, while the methodology was well-designed per se, with a strong theoretical basis, there are doubts as to what extent the householder opinions are a true picture of the realities of living in the houses.

This last point is reflected in the report’s executive summary, which raised crucial questions (Fletcher & Bridgman 2000, p. 3):

- Do comments on personal satisfaction reveal more about the Aboriginal respondent’s courtesy toward European Architects briefly visiting their settlement than their real feelings about their house?

- Should we be surprised that preference is given to a new house over an old, dilapidated, sub-standard house often without power, water or sewerage?
- Do the reservations about Aboriginal respondents, minor as they seem, conceal a greater dissatisfaction with the ability of new houses to accommodate social and cultural practices?
- Are the houses really a ‘success’ and in whose terms – Aboriginal, European, technical, financial, cultural?

The fact that these doubts were raised from the outcomes of the evaluation process indicates that a conventional approach to surveying houses will always have difficulty identifying local values, priorities, attitudes and behaviours. Hence, future research must engage in a settlement-level enquiry that will allow the deeper issues referred to in these questions to emerge over a longer time frame and to address the methodological problems identified in the *Living Spaces* report.

### Evaluation of Fixing Houses for Better Health

The Fixing Houses for Better Health (FHBH) Program is based on the Housing for Health methodology, and is funded by the Commonwealth Department of Family and Community Services to improve the capacity of Aboriginal housing. It entails a detailed ‘survey-and-fix’ methodology with focus on achieving capacity to maintain ‘nine healthy living practices’ as identified by Healthabitat (Pholeros, Rainow & Torzillo 1993).

FHBH is generally a one-off input into a settlement. While there is participation of local people in the process, there is limited scope for it to continue beyond the survey period unless it is specifically funded, or the settlement management has the capacity to fund and drive the methodology. Even though the methodology has been receiving funding from FaCS and the NSW Department of Aboriginal Affairs (DAA), there has been no widespread research to evaluate whether there have been long-term outcomes from the process. The only exception occurs in the Anangu Pitjantjatjara Lands in South Australia, where Nganampa Health Council, under the leadership of Stephan Rainow, has instituted a Housing for Health methodology in the ongoing maintenance of settlement housing. This is, however, no surprise, due to the fact that the Housing for Health methodology was developed on the AP Lands over many years from the mid-1980s, and Stephan Rainow was active in its development.

The FHBH Program relies on adequate funding to facilitate the contracting of plumbers and electricians to follow the survey teams, and to pay for all materials needed to fix houses. If a settlement is inadequately funded, a survey-and-fix approach is not possible.

Furthermore, it is a fundamental value of the FHBH program that the sustainability of Aboriginal housing is largely driven by design and specification, and that use behaviour is not significant (Pholeros, Rainow & Torzillo 1993).

Nevertheless, the Housing for Health methodology is an effective research and data collection tool; the data collected is finely detailed and will be particularly useful in the development of the lifecycles modelling tool, if available.

In 2004, FaCS commissioned an evaluation of the FHBH Program (Spring 2005). Like most evaluations before it, this evaluation focused on the accountability of the delivery side. There appears to be no evaluation of local views after the program has been completed in each settlement. The draft evaluation identified this as a problem in the terms of reference.

While there were informal interviews with settlement participants and representatives during the survey-and-fix process, there was no follow-up. The author recommended (Spring 2005, p. 4): ‘a comprehensive analysis of each community’s perceptions of the assessment and maintenance methods would involve a more involved consultation process over the fullness of time.’

Again, this suggests that there is a need to develop a long-term, settlement-level research process to uncover the real perceptions of people in desert settlements.

## IHANT surveys

From 2003, the then Northern Territory Government Department of Community Development, Sport and Cultural Affairs (DCDSCA), now the Department of Local Government (DLG), has been conducting surveys of settlement housing. Most surveying is done by Environmental Health Officers, with Community Development Officers of DLG mainly surveying outstations.

The survey design has been in part influenced by the Housing for Health methodology, in that some testing methods are used along with observations. There is no ‘fix’ component. The survey process is also limited by the time available.

The survey includes a one-page section of Customer Satisfaction Questions focused on maintenance of houses, with a very limited scope for understanding local perceptions of housing. The only question pertinent to this understanding is: ‘Is this a good house for you and your family? Why?’ (DCDSCA 2004).

In discussions with IHANT staff, the level of co-operation from outstation residents in responding to the survey is low: anecdotally, perhaps only 1 in 10 householders respond to the survey when asked, and of these the majority are dissatisfied. (G Eatts<sup>12</sup> 2005, pers. comm., 11 August) There can be many reasons for this level of response: dissatisfaction with government, protection of privacy, fear of being shamed, desire not to speak to strangers and dissatisfaction with the standard of housing (G Eatts 2005, pers. comm., 11 August).

The outcome of this process, while rich in data about the condition of the house, does not contribute to further understanding of the settlement perspective.

## Australian Institute of Health and Welfare Lifecycle Report

The Australian Institute of Health and Welfare (AIHW) carried out an investigation into the development of lifecycle models in 2001 (Sheehan, Jenkins & Phillips 2001). This was an early attempt to bring lifecycle analysis and modelling into the Aboriginal housing domain. While this report is not based on an evaluation of housing, it considers usage factors in the development of the model and data mining.

Consideration of the value of their approach, in terms of the structure of the model, has been made in the **Australian Remote Housing Models** section of this report. However, the AIHW consideration of local perceptions is relevant to this discussion of participatory methods and the local viewpoint.

The AIHW report identifies that how a dwelling is used is a key Aboriginal housing construct (Sheehan, Jenkins & Phillips 2001), and connects usage directly to longevity. In conceptual terms, use is considered as two distinct factors: settlement factors and tenancy factors.

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<sup>12</sup> Grahame Eatts was at that time a field officer in the then Department of Community Development, Sport and Cultural Affairs carrying out housing evaluation under the IHANT program, and a key informant of this study.

Settlement factors include settlement size, available services, settlement viability and overcrowding issues. Tenancy factors include the links between good housing and the ability for people to participate in the life of the settlement, and so occupancy rates, education levels, socio-economic status and health status are considered. The classification of these factors begs the question of what kinds of things people do in and with their houses. The AIHW makes the assumption-by-default that their tenancy factors cover all behaviours. So, good socio-economic and health data will apparently be enough for the local usage factors in this model.

It is clear that the AIHW approach to lifecycle modelling only considers the impact of the dwelling user in terms of broad statistical patterns. An opportunity exists to develop the conceptual thinking about housing lifecycles to include a more realistic view about local usage.

### Summary of evaluations

The brief review of the above evaluations highlights the difficulties of understanding local settlement perceptions, values, attitudes and behaviours towards housing. Some of the reports, particularly the *Living Spaces* report, are very clear about the limitations of direct, short-timeframe survey methods; the FHBH review indicates that time is needed to gain the local housing story.

In response to the experiences summarised above, a long-term process is needed; one that is embedded at the settlement level, allowing time for the deeper meanings of housing to emerge.

## The Housing Stories approach to evaluation

Service delivery in the area of housing, infrastructure and settlement planning has generally been focused on ways of transferring essentially Western technical solutions to remote Aboriginal settlements.

While such service delivery programs and projects have been framed with financial accountability and managerial rigour, and often with settlement consultation, there is much research required to investigate whether such programs are sustainable in desert settlements in the long-term, and whether they contribute to ecologically sustainable development and support sustainable livelihoods. The sustainability of housing as a long-term lifecycle has not been a priority in the housing delivery process in desert settlements, given the massive shortfalls in housing stock and their condition. There has been little research on the lifecycles of Aboriginal housing, let alone instituting lifecycle models in the procurement and management of housing.

A missing factor in the sustainable development of desert settlements is the understanding of the experience of desert people in their day-to-day living with the outcomes of planning, infrastructure and housing delivery programs and projects, and, in particular, the value that desert people place on such technical solutions. The lived experience often has no feedback pathway to influence planning, housing and infrastructure delivery and maintenance systems to suit local needs, values and processes.

However, given that the views of desert settlements are not adequately identified and incorporated into the whole lifecycle process of housing, infrastructure and settlement development, any research project hoping to identify and model the lifecycle of housing in remote settlements must take this into account. Local housing stories based on the lifeways, values and housing preferences of desert people must be told.

As summarised previously, the evaluation of housing programs is often focused on supply-side accountability, and not accountability on whole-of-life performance. Some of the above evaluation processes have identified this as a flaw in the terms of reference of their evaluations, and identified that settlement-level evaluations are needed to tell the whole story. Thus a key rationale of any future research is to extend the evaluation process beyond the supply side, to an extended demand-side, settlement level process.

The Housing Stories approach, then, seeks settlement-level evaluations of technical solutions for housing, infrastructure and settlement planning, imported and local, and will direct the knowledge gained from those solutions in a reverse technology transfer process to outside agencies and consultants. While focus is on the imbalance of knowledge flow in housing, infrastructure and settlement planning, the project will also report on local ways of learning and knowing about technology.

A key aspect of the Housing Stories approach is that research actions are based on service to desert peoples in exchange for access and information.

To summarise, the Housing Stories approach has the following broad objectives:

- to investigate the roles and capacities of desert people in sustaining their housing and infrastructure through Participatory Monitoring and Evaluation (PME) processes
- to determine the value placed on local and imported technical solutions by desert people
- to contrast the outcomes of desert people's local evaluations of housing, and infrastructure with the outcomes of project evaluations usually conducted by funding agencies
- to identify gaps between local knowledge and outside data, and feed this information via a reverse technology transfer process to influence the development of lifecycle models for use in policy development in funding and regulatory agencies, and by housing and infrastructure consultants
- to provide a service in return to participating settlements, including data, stories, multi-media, education and capacity building through PME processes and training of Settlement Researchers.

## Housing Stories research questions

As future research into housing-for-livelihood cannot be fully addressed without local-level enquiry, the Housing Stories approach can extend them across a number of theme areas: lifeways preferences, participation in development and design, housing preferences, settlement management, occupant behaviour and management, affordability and financial management, and technacy.

### Mode of questioning

Research is about framing questions and seeking answers to those questions. However, questions in the Aboriginal domain can be problematic: they can be confronting or offensive to people. There is ample anecdotal experience of the feelings of Aboriginal people about the arrival of researchers with clipboards on their doorsteps. There is an assumption inherent in surveying that people answer questions honestly, openly and thoroughly. This is questionable, even in mainstream Australia. The Living Spaces experience and the IHANT customer satisfaction survey, as outlined in **Housing and Infrastructure Evaluations**, are cases in point.

Even though an extensive range of questions has been framed, the challenge in the Housing Stories approach is to create a process that will allow meaningful answers to emerge from participation in a dialogue with local people over a long timeframe. Thus the research questions should be considered as a means to focus the researchers, so that they can recognise meaningful living patterns as they emerge and adapt their approach in more sympathetic ways according to differing contexts.

## Themes for research questions

### *Lifeways preferences*

All people act out in some way their inherent preferences for living, whether they are in full control of their physical settlement environment or not. People interact with their buildings and technology by adapting to situations or manipulating situations according to inner and outer drivers. It cannot be assumed that a person's adaptive interaction with their buildings and technology is a fully conscious activity. Research questions should be designed to articulate desert peoples' preferences for living well on country, commensurate with their lived behaviour.

### *Participation in development and design*

Many desert settlements have inherited imposed settlement layouts and imposed housing designs, and have had minimal participation in technology choice. There has been much discussion in development circles about the value of participation. Participation by local people in settlement development has often been regarded as one of the factors of success, with the consequence that many funding programs now require participation by local people. It is questionable, however, whether participation has been sufficiently valued, and whether projects have actually been structured to foster deep involvement of local people. Research questions should clarify levels of participation.

### *Housing preferences*

In desert settlements, design of houses rarely starts with a blank sheet of paper. While there have been many examples of innovative attempts to design houses suitable for non-Western lifestyles, most designs are variations on similar themes. Building consultants have historically used standardised plans for desert housing. There was a move by some designers away from this approach, but in recent times, housing delivery models have returned to a standardised approach, such as the approach of the Central Remote Housing model of IHANT. Standardisation is about economies of scale, controlling costs and fostering a standard approach to house maintenance and the capacity to maintain. It is unclear how well people adapt to standardised situations and whether this has been well received by desert people. The research questions under this theme should be about identifying local preferences for housing, under both standardised and more flexible approaches.

### *Settlement management*

Housing and infrastructure delivery systems vary from state-to-state, particularly the extent of post-construction control by settlements. In the Northern Territory, houses are handed over to settlement ownership and management, with the implicit assumption that responsibility for the condition of housing and infrastructure is at the Settlement Council or Resource Centre level. Yet there are major process and capacity gaps at the settlement management level, subject to sometimes unrealistic expectations from occupants, on one hand, and governments, on the other.

The combination of these expectations and capacity gaps creates a volatile mix that has generally contributed to low lifecycle rates. While the mode of housing delivery is undergoing review, local capacity to manage will still be a significant factor.

### *User behaviour and management*

With the advent of permanent desert settlements, the built environment has now become a principal place of mediation between traditional and modernist lifeways. The technology of the house, particularly the funded, standardised, codified version, has an embedded culture of funding, design, construction, usage and maintenance. For desert people, this embedded culture is not always obvious, acknowledged and valued, with substantial discontinuity in understandings of how to manage and maintain their housing. Research questions should be aimed at discovering the user issues at the point of mediation.

### *Affordability, home ownership and financial management*

The house-as-mediation idea as described in the previous theme has an associated concept, whereby the process of procurement of housing (as opposed to the housing product) is another domain of mediation between traditional and modernist lifeways. If management of physical housing stock is difficult enough for desert people, the issues of housing affordability and capacity to manage money to procure accommodation are even more complex, and have considerable bearing on lifecycle issues. Research questions should help map this complex area.

### *Technacy*

One of the Key Research Questions of the Lifecycles Project concerns the identification of knowledge gaps in capacity defects for existing lifecycle models. Future research would review local settlement management of housing and individual household behaviour in terms of the Technacy model. Discussions of knowledge gaps in capacity defects can be rendered more meaningful through application of Technacy ideas.

While detailed research questions can be articulated in a somewhat linear way, in reality the process will not be one based on direct questioning, especially asking each question in isolation and in a confronting way. A more integrated holistic and participatory approach based on people's housing stories should be implemented, where the answers may emerge from an ongoing dialogue and storytelling. The method is explained in the next section.

## Housing Stories methodology

### Theoretical basis for participatory monitoring and evaluation

Participatory Monitoring and Evaluation (PME) is a key community development process developed by Prof. Robert Chambers and others of the Institute of Development Studies, University of Sussex, United Kingdom, and is aimed at enabling local participation in projects and processes to emerge. It can encompass design, planning, decision-making, analytical and evaluation processes. This approach is well documented (Chambers 2000, 2002; Davis-Case 1990; Guijt, Arevalo & Saladores, 1998; Guijt & Gaventa 1998; Walsh & Mitchell 2002; Wates 2000), and has been used extensively in community development processes in the developed world, developing countries and third-world settlements. It has also been used in desert settlements in health, planning and housing projects, but only as the preference of individual consultants and field workers, and not as a core project activity.

## *Principles of participation in development*

Participatory Monitoring and Evaluation arises from a family of approaches to development promoting and facilitating participation of all stakeholders in the community development process. Chambers (2002, p. 2) describes the participatory approach to community development as:

*a growing family of approaches, methods, attitudes and behaviours to enable and empower people to share, analyse and enhance their knowledge of life and conditions, and to plan, act, monitor, evaluate and reflect.*

This approach combines a family of methodologies in continuous evolution, and as such goes by various acronyms, terms abbreviated for ease of use: RRA, PRA, PLA and PME (Chambers 2000, 2002; Pretty et al. 1998a, 1998b).

Rapid Rural Appraisal (RRA) developed as a means of quickly gaining local information in third world rural development projects in the 1960s and 1970s. Many of the techniques pioneered in RRA are still in use, although RRA is now not viewed as holistic and participatory. Participatory Rural Appraisal (PRA) was an evolution of RRA, with an emphasis on participation and de-emphasis of the rapid gathering of information. It is now more commonly referred to as Participation–Reflection–Action to incorporate the need for participants to reflect on the process as it unfolds. More recent methodologies are referred to as Participation–Learning–Action (PLA). Participatory Monitoring and Evaluation (PME) is a particular application of participatory methodology, where settlement participants determine what is to be monitored and evaluated, and how.

The PME process gives voice to people who are normally excluded from project monitoring and evaluation; it also gives voice to those end users who may be consulted as part of conventional evaluations, and yet have no role in shaping and directing the values, statutory requirements, scope and process of monitoring and evaluation.

The philosophical basis of participation is embodied in the following questions (Chambers 2000):

- Whose reality counts?
- Whose knowledge counts?
- Whose criteria counts?
- Whose analysis counts?
- Whose priorities counts?
- Whose planning counts?
- Whose action counts?
- Whose monitoring and evaluation?
- Who participates in whose project?

This philosophy contends that these questions must be uppermost in the researcher's mind when engaging in settlement-based research, with an implied assumption that the researcher is not detached or neutral. Researchers become participants and this influences the way information is gathered and analysed. A spirit of optimal ignorance and appropriate imprecision is engendered, whereby no more information than necessary is sought and information is compared rather than measured (Chambers 2000). Finally, participatory action research must be an open process in terms of its ethical and political implications. It must be open to change from the participants (Chambers & Guijt 1999).

The principles of participatory approaches are many, constantly developing, iterative and fluid. Notes from *A Trainers Guide for Participatory Learning and Action* (Pretty et al. 1995) describe the shared principles of participatory approaches as:

- **a defined methodology and systematic learning process:** the focus is on cumulative learning by all the participants
- **multiple perspectives:** a central objective is to seek diversity, rather than to simplify complexity
- **group learning process:** involves the recognition that the complexity of the world will only be revealed through group analysis and interaction
- **context specific:** the approaches are flexible enough to be adapted to suit each new set of conditions and actors
- **facilitating experts and stakeholders:** the methodology is concerned with the transformation of existing activities to try to improve people's situations
- **leading to change:** the process of joint analysis and dialogue helps to define changes which would bring about improvement and seeks to motivate people to take action to implement defined changes.

Chambers (2002, p. 3) adds the following to this list:

- **self-aware responsibility:** individual responsibility and judgement exercised by facilitators, with self-critical awareness, embracing error
- **equity and empowerment:** a commitment to equity, empowering those who are marginalised, excluded and deprived, often especially women
- **diversity:** recognition and celebration of diversity.

Participation can occur in different ways and to different degrees. There is a continuum from a point where people are kept informed of a process by those in control of a process through to where there is a high degree of autonomy and control over decision-making. This has been described in different terms in a number of publications (Wates 2000, p. 10; Walsh & Mitchell 2002, p. 22; Pretty et al. 1998a, p. 2), and is summarised in the following (Table 6):

Table 6: Levels of participation

Level of participation	Description	Role of local people
Passive or compliant	People are told what to do and what will happen	Spectators
Coercive participation	Participation through material incentives	Subordinates
Information gathering	Answering questions: extractive	Subjects
Consultation	Outsiders ask for local views	Clients
Functional participation	People participate in process with pre-determined objectives	Collaborators
Interactive participation	Shared responsibility between locals and outsiders	Partners
Self-mobilisation	Local people initiate and run processes	Directors

The intent of the Housing Stories approach is to engage with desert people in the bands from consultation to interactive participation. The level of participation identified as self-mobilisation may not be achievable.

### Problems with participatory methods

Participatory methods can be problematic, depending on the point of view. The time taken to allow a participatory process to unfold can be seen by some as too slow, lacking rigour and generating unreliable data. Outside professionals and bureaucrats often identify the following issues to argue against participatory approaches (Sanoff 2000, p. 22):

*Some professionals argue that participation is not necessary, and often undesirable for eventual users to participate in design and planning, inasmuch as they do not have the necessary expertise and often get in the way.*

*Because everyone has a different opinion, you will get as many answers as the number of people you ask. Another, contradictory, argument is that people are so similar that their needs are undifferentiated.*

*Participation can be threatening to professionals and managers who feel it threatens their role as experts since it implies shifting decision control to users.*

*Involving users is more time-consuming, and therefore more expensive, than relying on professionals who have broad experience and specialized knowledge.*

*The lack of adequate experience by professionals, government officials, and managers in working in collaboration with users can limit the effectiveness of participation.*

*Often, the people involved do not represent the majority but are, rather, citizens who represent special interests.*

*There is a danger that the entire process turns out to reflect the aphorism that a camel is a horse designed by committee. Everything is likely to end up as a compromise.*

These outsider views are reinforced by Pretty and others (1998a, p. 80):

*The dilemma for authorities is that they both need and fear people's participation. They need people's agreement and support, but they fear that this wider involvement is less controllable, less precise and so likely to slow down planning processes. But if this fear permits only stage-managed forms of participation, then distrust and alienation are the likely outcomes.*

Chambers (2002, p. 5) states that participatory techniques are not immune from bad practice, and that lack of quality assurance has been of great concern. Chambers identifies the problems as:

- using the label without the substance
- failure to put behaviour and attitudes before methods
- rushing and dominating in the field
- donors' demands for training in a day or two, with lecturing, without fieldwork, and followed by implementation in settlements as a one-off in a short time
- donors and governments demanding instant PRA on a large scale.

While structures imposed by bureaucrats and the protectiveness of professionals of their careers are significant factors, participation facilitators can also be part of the problem. Another view of the problematic aspect of participation states (Forester 1999, p. 115):

*Inspired by liberal models of voice and empowerment, many analyses unwittingly reduce empowerment to "being heard" and learning to considering seriously local as well as expert knowledge. Participation is thus reduced to speaking, and learning is reduced to knowing – and the transformations of done-to into doers, spectators and victims into activists, fragmented groups into renewed bodies, old resignation into new beginnings, are lost from our view.*

These points of views become valid if participatory processes are not properly facilitated, and the primacy of behaviours and attitudes (Chambers 2002) is not maintained. Researchers need to stay mindful of these issues, and should continually reflect on process and outcomes.

## Participatory methods in Aboriginal Australia

### Uses of participatory methods

Participatory methods have been used extensively in Aboriginal Australia, in the health, land management and built environment domains, among others. Participatory methods are usually applied in planning, design and communication processes. Some examples are:

- Mona Mona Settlement Planning, Qld (Groome 1999)
- Juwurlinjin Settlement Planning, Kimberley Region, WA (Anda 2001)
- Land Management Planning at Loves Creek Station, NT (Mahney 2002, p. 122)
- Warlmanpa ground mapping for Land Use Planning, NT (Walsh 2002, p. 129)
- The Money Story Game for managing cattle enterprises, NT (Mitchell 2002, p. 136)
- Buru Settlement Planning, Qld (Levers, Martin & Eriksson, 2001)

However, participatory methods for monitoring and evaluating projects and processes in Aboriginal settlements appear to be little used, at least in Central Australia (Walsh & Mitchell 2002). There is an example of a participatory evaluation approach in a process of developing a governance model for an Aboriginal public housing association (McIntyre 2002), but there is little detail about it in McIntyre's article. The process links both design and planning into the ongoing monitoring of the planning-in-action and evaluation of the outcomes.

The use of participatory monitoring and evaluation processes in the review of housing and infrastructure in desert settlements is likely to be a first for Aboriginal Australia.

### *Constraints on participatory methods in Aboriginal Australia*

Walsh and Mitchell (2002, p. 23) outline a number of crucial constraints likely to impact on the use of participatory methods in Aboriginal Australia. While some of these are typical of constraints in the international experience, the constraints nevertheless make it incumbent on facilitators to be particularly sensitive to local contexts. These are summarised as:

- **Pressure to tailor 'success' to the values of outsiders:** Accountabilities for funding are aligned with the values of the funding agency.
- **Aboriginal landholders cannot be heard:** There is no guarantee that decisions made by Aboriginal people through participatory processes will be accepted by funding agencies.
- **Private and public benefit and the notion of 'community':** Commitment to public processes is dependent on private benefit. Private benefit depends on the size and type of social unit, so that benefit to the social unit is perceived as benefit to the individual.
- **Misuse of Aboriginal intellectual property:** The potential for misuse may affect open exchange of information.
- **Participatory planning is seen as patronising:** The visual methods could be seen as playing children's games in the absence of knowledge about use of participatory methods in developing and developed countries.
- **Aboriginal languages and 'high' English:** English is not enough – people have a right to express themselves in their own language – and plain English should be used.
- **Recording and keeping plans in the outstation:** recording is vital, but focus on record-keeping can take focus away from deep listening and dialogue.
- **Appropriate tools have not been determined:** most of the participatory tools have been developed outside Aboriginal Australia. There should be scope to develop local tools.
- **Networks and information systems:** inability to link up for information sharing is problematic.

Walsh and Mitchell (2002, p. 31) also identify some key contentious questions, with significant implications for participatory approaches in Aboriginal Australia:

*Gatekeeping or sharing knowledge? Gatekeeping concerns the impacts of umbrella organizations that are protective of communities, and can potentially reduce opportunities for local decision making.*

*Shared ownership or 'strings attached'? The latter may suit some, as Aboriginal people may not be ready for partnership-based relationships, preferring passive compliance in donor-recipient relationships.*

*Are participatory planning methods too vague or too prescriptive? When partnerships do eventuate, people may be more comfortable with a prescribed rather than open method, because the open method may appear too vague.*

*When to plan? When to act? While Aboriginal people don't want to be rushed into decision making, they also can grow frustrated if planning is drawn-out, and action is slow to start.*

*Do Aboriginal landholders support participatory planning? Aboriginal participants were supportive of participatory methods, but a few were critical.*

*Can Aboriginal people be facilitators in their own country? There is also difficulty for Aboriginal facilitators on their own country where they may have to deal with avoidance relationships or pressure from clan affiliation.*

*Avoid groups where there's conflict or jump right in? Be prepared to respond to conflict rather than run from them.*

*Are democracy and gender equity compatible with Aboriginal decision-making? Participatory methods should not be an imposition on Aboriginal decision-making methods.*

*How much should planning cost? Costs and cost-effectiveness should be gauged according to the values identified by Aboriginal people.*

*Do computers and GIS help or hinder people? Determine who benefits and whether time and money could be better allocated.*

The experiences described in *Planning for Country* (Walsh & Mitchell 2002), do indicate that there is general satisfaction with participatory methods, although some cynicism exists about their long-term value and whether local voices will be heard by funding agencies.

## Participatory monitoring and evaluation

Conventional monitoring and evaluation of projects and processes is conducted with predetermined accountability criteria that reflect the values and priorities of the outside stakeholders, not of the end user; this is particularly problematic in cross-cultural contexts, where poverty is the norm, and where there is limited capacity to negotiate performance benchmarks with government agencies. The problems of conventional evaluations were reviewed in **Housing and Infrastructure Evaluations**.

Conventional evaluations have been described as being from the reductionist tradition of scientific investigation characterised as (Estrella & Gaventa 1997, p. 14):

- focused on measurement

- oriented to the needs of program funders and policy makers, rather than participants and local people
- striving for objectivity, and distance between evaluator and participants
- conducted for the purpose of making judgements rather than empowerment.

Estrella & Gaventa (1997, p. 15) go on to summarise the major criticisms of conventional approaches to monitoring and evaluation:

- *They have proven costly and ineffective in terms of measuring and assessing project achievements.*
- *They have failed to involve actively project beneficiaries and others who may be directly affected by M&E.*
- *Project Evaluation has become an increasingly specialised field and activity, conducted and controlled mostly by outsiders and removed from the on-going planning and implementation of developmental initiatives.*
- *They serve primarily as a tool to control and manage programmes and resources, alienating intended beneficiaries and others involved in the programme planning and implementation from taking part in project appraisal.*
- *Emphasis on quantitative measures tends to ignore qualitative information which helps provide a fuller understanding of project outcomes, processes and changes.*

Participatory Monitoring and Evaluation (PME) processes have emerged through an understanding of the limitations of the conventional approach and enables development organisations and settlements to focus more on improvement of people’s lives (Guijt & Gaventa 1998, p. 1). PME processes give voice to people who are normally excluded from project monitoring and evaluation; it also gives voice to those end users who may be consulted as part of conventional evaluations, and yet have no role in shaping and directing the values, statutory requirements, scope and process of monitoring and evaluation.

The differences between conventional and participatory evaluation have been summarised by Narayan-Parker (1993, p. 12) in Table 7.

Table 7: Conventional versus participatory evaluation

	Conventional	Participatory
Who	External experts	Settlement members, project staff, facilitator
What	Predetermined indicators of success, principally cost and production outputs	People identify their own indicators of success, which may include production outputs
How	Focus on 'scientific' objectivity; distancing of evaluators from other participants; uniform, complex procedures; delayed, limited access to results	Self-evaluation; simple methods adapted to local culture; open, immediate sharing of results through local involvement in evaluation processes
When	Usually upon completion of project/program; sometimes also mid-term	More frequent, small-scale evaluations
Why	Accountability, usually summative, to determine if funding continues	To empower local people to initiate, control and take corrective action

## Benefits of participatory monitoring and evaluation

A participatory approach was proposed because it increases the chances of obtaining a fuller picture of what value people place on their housing, their usage behaviours and critical events that impact on the life of housing. The problems are similar to those previously identified for participatory methods generally, but it is useful to summarise some potential benefits as outlined by Karen McAllister (1999, p. 33):

- Researchers and settlements can benefit directly from the lessons of the evaluation.

- Information can be defined by the settlement for its own purposes, to track environmental and social change and to help in settlement decision-making.
- Researchers and settlements have ‘ownership’ of the results and are more likely to internalise the lessons learned.
- The capacity of researchers and settlements in evaluation and participatory research is strengthened.
- Researchers are encouraged to be more reflective about the research strategy and be more alert to the social dynamics and relations of power which influence outcomes.

## Participatory methods tool box

In the Housing Stories approach, a suite of specific participatory research and analysis techniques, that is, a participatory methods ‘tool box’, can be used. This section summarises some useful tools, many of which have been used in participatory processes in both the developed and developing world. There are tools for facilitators; tools for use at council, pan-community and community group levels; and tools for use by families and individuals.

The participatory process will be responsive so that methods can evolve in ways sympathetic to priorities of local people. As stated previously, it is hoped that research techniques will also be developed by local people: this project is based on the principle that desert people are experts on lifeways in remote settlements and will make their own input to the project. Thus the participatory approach should be considered as iterative or a work in progress.

PME techniques can often be highly visual, not only because of literacy and numeracy issues, but because visual presentations of issues and ideas can be more easily expressed to groups of people. Further, they can be effective with people and cultures with a strong orientation to visual-spatial communication methods.

Visual tools can be sophisticated in concept, but simple in implementation, such as simple diagrams drawn by a stick in the sand. There may be times when more sophisticated, prepared graphics are required, such as those used in the Bushlight program operating out of the Centre for Appropriate Technology in Alice Springs. For Bushlight’s Community Energy Planning Workshops (CAT 2003), simple symbols denoting different energy sources and quantities of energy were used as aids in communication of critical issues.

Many of the tools involve verbal communication, particularly through storytelling. This raises the issue of interpretation, which can be helped by identifying bilingual people as Community Researchers. Since the nature of the interaction with settlements will operate at different levels, from settlement council level to community interest groups to clan, family and individual levels, different tools will be more useful in different situations. Further, given the involvement of Community Researchers down to the family and individual levels, PME tools will need to be appropriate for them to use effectively.

### Tools: Facilitators and researchers

Nick Wates, in *The Community Planning Handbook* (2000, p. 11), outlines some broad guidelines to be used as tools by facilitators. Table 8 lists some key tools.

Table 8: Tools for facilitators and researchers

Accept different agendas	Now is the right time
Accept limitations	Personal initiative
Accept varied commitment	Plan your own process carefully
Agree rules and boundaries	Plan for the local context
Avoid jargon	Prepare properly
Be honest	Process as important as product
Be transparent	Professional enablers
Be visionary yet realistic	Quality not quantity
Build local capacity	Record and document
Communicate	Respect cultural context
Encourage collaboration	Respect local knowledge
Flexibility	Shared control
Focus on attitudes	Think on your feet
Follow-up	Train
Go at the right pace	Trust in others' honesty
Human scale	Use experts appropriately
Involve all those affected	Use facilitators
Involve all sections of settlement	Use local talent
Learn from others	Use outsiders, but carefully
Local ownership of the process	Visualise
Maintain momentum	Walk before you run
Mixture of methods	Work on location

These tools for facilitators should be used to guide the selection and application of tools for use at the settlement level; they strongly reinforce the need for facilitators to plan their approaches well.

## Tools: Council, pan-community and community Group

### *Participatory Community Workshops*

(Chambers 2002, p. 11; Davis-Case 1990, ch. 8; Walsh & Mitchell 2002, p. 44; Wates 2000, p. 64)

Early involvement with settlements is likely to be at council and pan-community levels, with emphasis on local research design. Interactions are likely to be introduced through a formal workshop process to facilitate a broad community response and to identify Community Researchers. Workshops would also be held with Community Researchers for training in the use of participatory tools.

Formal workshops enable the exploration of issues where there is an opportunity for information exchange, discussions, proposals, responses and decision-making. However, these activities tend to work best when key people are present, especially if decisions/resolutions are to be made. They can be intimidating, so it is important that indirect processes, properly facilitated, are used.

Many of the techniques described below could be used as tools in community workshops in addition to individual applications. Mind-mapping in particular is a good technique for recording the process of the workshop.

### *Small group workshops*

(Chambers 2002, p. 11; Davis-Case 1990, ch. 8; Walsh & Mitchell 2002, p. 42; Wates 2000, p. 64)

Continuing workshops would be held with different stakeholder focus groups in the settlement: elders, the young; men, women; teenagers, children; or health workers, maintenance/building crews, council staff, store staff, artists groups, school staff and so on.

Small group workshops can be a way of fostering storytelling, where the storytellers have the scope to define the direction and priorities of their story. These groups can also provide good opportunities for mutual learning about housing and infrastructure.

When trialling of prototype, settlement-level, lifecycle computer models is ready (for future research), small group work will be the major participatory tool for information exchange and for engaging in the transfer of the technology to community use.

### *Modelling*

(Burnham 2002, p. 72; Walsh & Mitchell 2002, p. 42; Wates 2000, p. 82)

Models of settlement layouts, housing sites, house designs and technologies can be useful for drawing out discussions around particular issues. In built environment communication, physical models are almost more fully understood than drawings of the same thing, regardless of cultural or educational background.

Models can be reasonably portable: they can be left in semi-public places such as council offices and women's or youth centres, so that people can take their time to think through any issues and consider their responses. Any accompanying text can be in local language, if appropriate. Response timeframes can be days or weeks, rather than on-the-spot in workshop situations.

### *Posters*

(Davis-Case 1990, ch. 8; Walsh & Mitchell 2002, p. 133)

Graphic representation of particular issues can likewise stimulate discussion and thinking. These need to be used in a targeted way for specific issues or else they can become wallpaper. Posters work best as a pro-active communication tool in community workshops. Like models, they can be left in place as part of an ongoing process, especially linked with an interactive, visual display, such as a priority matrix.

There is scope in the project for local artists to be employed to produce graphics for posters and other visual 'cue cards', using traditional symbolism and graphic storytelling.

### *Informal walks*

(Chambers 2002, p. 10)

Informal walks around settlements are useful for facilitating mutual learning and information exchange. Local people would be invited to educate the researchers in issues of concern or priority, and about conditions in the settlement generally. The itinerary of these walks is determined by the informant, not the researcher's checklist. The experience gained from these walks can be fed back into other processes such as priority matrices (see above) to promote further reflection, analysis and discussion.

### *Transect walks/drives*

(Chambers 2002, p. 10; Walsh & Mitchell 2002, p. 48)

Transect walks are more directed than informal walks, yet still facilitate new information or stories to be told. Transect walks may have a theme or focus, such as to look at the variation in housing types across a settlement or to learn about issues affecting safe food storage. To this extent the subjects of transect walks may be proposed by the researchers or by local people, either directly or indirectly through the outcomes of workshops and focus groups.

## *Classifying and ordering ideas, strategies and actions*

(Burnham 2002, p. 88; Walsh & Mitchell 2002, p. 56; Wates 2000, p. 104)

Graphic devices such as Priority Matrices and Venn (or Chapatti) Diagrams, or Seed Techniques, can be used to determine relationships between issues and the relative strength of those relationships; they are also used to determine priority issues and actions. They provide scope for local people to decide what the crucial issues are and the nature of their interrelationship.

Priority matrices are usually square or rectangles with rows and columns that can be assigned qualities or issues to be analysed. Placing signifiers or markers with agreed values in a particular square indicates a decision or value judgement about intersecting issues. The matrix and markers do not have to be sophisticated. Natural found materials can be used: seeds, stones, sticks, beads, coloured chalk or other locally derived signifiers can be used to indicate preferences and priorities. Cards, paper or Post-it notes are also suitable. They can be made at ground level outside, floor and table level inside, and on walls, sheets of plywood or whiteboards.

Priority matrices have been used extensively in third world development processes, and have been found to be useful in helping to focus on relevant issues, resolving conflicts, and in opening processes to women, young people and other traditionally disempowered people.

In *The Community Planning Handbook*, Wates (2000, p. 105) describes two variations on priority matrices: the wheel method and the fence method. The wheel method identifies the issues, then creates a wagon-wheel shape with a number of segments equal to the number of issues identified. Each segment is identified by issue. Participants place cards or sticky notes (generally with three priorities) on their priority issue segments. Discussion and analysis can take place using the wheel as a focus. The Fence method enables identified issues to be assessed by a continuum of possibilities with a place in between called the 'fence', which indicates no strong views either way.

Venn diagrams made of cardboard disks are used to identify relationships, their strength and priorities. Participants can use objects to act as symbols of relevant issues, placing them on the cardboard disks.

## *Mapping*

(Burnham 2002, p. 69; Walsh & Mitchell 2002, p. 58)

Like modelling, mapping is a process that helps people identify the scale and spatial relationships of settlement buildings, housing, facilities and infrastructure. Maps can be literal, reflecting the physical settlement; they can also map unseen or opaque activities and relationships, such as tribal or clan areas, sacred places and other behaviours of value or danger. Often made as a discrete activity in community workshops, they can then be extended for use as a tool for considering a range of issues or for proposing changes.

Techniques can be drawings in the sand, using sticks and rocks to denote features of the natural and built environment; coloured chalk on paved surfaces; sand models with paper and wood blocks applied as features; table-top models using cut-up paper and cardboard; or professionally made models.

Mapping activities can also be used to identify seasonal changes in climate and social activities which impact on housing and infrastructure.

## Tools: Families and individuals

### *Housing Lifecycles Story Card*

(Fletcher & Bridgman 2000 p. 66)

When any evaluation process reaches the household level, it cannot be assumed that information about the evaluation process has reached all residents. To facilitate the introduction of the project, a story card, using mainly graphics and some text (in language and in English), can be shown to the householder to assist in explaining the purpose of the visit, the benefits to the householder and to the researchers.

### *Unstructured interviews*

(Burnham 2002, p. 86; Walsh & Mitchell 2002, p. 54)

During field research, opportunities arise to sit down with people to hear their stories. Researchers need to be able to respond to such opportunities, even if there is no immediate scope to note the nature of the discussions. Such opportunities may arise as a result of reflections on issues discussed in workshops. Often the direction of these interviews is driven by the local interviewee, with the researcher asking questions of a clarifying nature.

The value of the unstructured approach is that it allows new priorities and issues to be floated, or new perspectives on issues already discussed. This approach may be used more frequently by Community Researchers.

### *Semi-structured interviews*

(Chambers 2002, p.10; Walsh & Mitchell 2002, p. 54)

Semi structured interviews are a more formal process, usually with pre-arranged times and topics. Structure is derived from the scope of the questions, usually composed by the researcher in advance, or in discussions with the interviewee.

These interviews are usually recorded by notetaking, tape recording or video.

These interviews would not be used early in the research project; they are better suited to use after substantial relationship building and broader community and focus group workshops have occurred.

### *Photography/video surveys and interviews*

(Burnham 2002, p. 87; Davis-Case 1990, ch. 8)

Photography and video are used regularly to record information in field research. While there is a place for researchers to use these techniques directly, a participatory process will turn the photography and video processes over to community people, or at least, to community researchers. This is a process whereby local people can tell their housing stories in a non-threatening, and most likely, fun way. Researchers may not necessarily get broad coverage of the issues, but data of a very deep nature is likely to emerge.

This approach could be particularly appropriate for engaging young people in the process, especially in using cameras to tell stories.

The researchers can make available video footage for the community to keep, or to turn raw video into interactive DVDs which could be used by the community in future consultations with planning, design, building and engineering professionals. Easy-to-use programs like iMovie and iDVD can facilitate this, and may provide further opportunity for capacity development for community people or community researchers.

Another advantage of video surveys is that local languages can be used and translated at a later time.

### *Learning-by-doing*

(Burnham 2002, p. 65; Walsh & Mitchell 2002, p. 50)

There will be times when the best way to collect information and stories is by engaging people in a meaningful, focused, real-world activity, often called learning-by-doing. By engaging in real world activities, such as house surveying and fixing<sup>13</sup>, individuals and families can experience immediate benefits, through small house improvements and the learning experience of householders and researchers can also be heightened.

Sessions with individual householders could be accompanied by a hands-on training activity focused on simple repair actions for common problems, using a few simple tools. This could be about fixing taps, unblocking drains, cleaning window tracks, screwing on door handles, tightening or replacing toilet seats, tightening or replacing toilet roll holders, cleaning or changing shower roses. A kit could be left behind with some simple tools, such as a screwdriver and shifting spanner, spare screws, light globes, toilet paper and sink plugs. It is recommended that the budget for future research include an allowance for the purchase of the householder's kit and items for replacement.

Designing a learning-by-doing process will largely be in response to particular settlement contexts, and is most likely to arise from the application of other participatory processes identified previously.

Learning-by-doing will be a major participatory tool when settlement-level lifecycle modelling software becomes available for trial and development. This will occur at the housing management level.

## Community partnerships

### Facilitating field research

The first step in a participatory approach is to begin a process of building relationships with participants. Without the willing co-operation of communities, future research cannot achieve its aims.

Given the exploitative nature of much research in remote Aboriginal settlements in the past, building relationships can be problematic. It can not be expected that people in settlements will generally be open to participating in the research.

There is a fundamental issue in the DKCRC project structure regarding community engagement that does not appear to be well understood, that is, the length of time it takes to develop community relationships to a level of trust whereby real field research can be undertaken in partnership with people in Aboriginal settlements. This aspect has major implications for the success of the Housing Stories approach. For partnerships to develop, and discussions with communities to be effective, it is essential that research actions be presented as a long-term process.

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<sup>13</sup> Based on Healthhabitat's Housing for Health methodology

## Community partnerships and return of service

Outcomes can only be achieved with the full support of desert people in remote settlements, hence the importance of having more than access agreements: to further the research, community partnerships are needed. Partnerships between communities and researchers present opportunities for mutual benefit.

Future research will involve extensive in-the-field engagement with desert people over a period of years, which may be considered as highly intrusive. Partnerships should only be pursued with communities who see the value of the research program, and who see the potential to work together on issues of mutual benefit. Consequently, the intent of project researchers should be to engage sensitively with communities, settlement organisations and desert people generally, by maintaining an ethos of providing a return of service to partner organisations and settlements.

While the broad outcomes of the Housing Stories approach have the potential to provide benefits to communities across desert Australia in the long term, the time involved may be too long for desert people to consider a benefit has been returned. As a result, future research should provide a mixture of immediate and short-term return of service.

The main avenue for return-of-service can be through the employment of Community Researchers. Not only can community Researchers help with information collecting at the settlement level, they can also be active in helping to design settlement-based research activities. A DKCRC-wide policy and accompanying guidelines for the appointment of Community Researchers has been developed. Community Researchers, in addition to earning income, can receive training and ongoing mentoring in the hope of developing a new career path for desert people.

The nature of return-of-service is part of open discussion with communities leading to community partnerships. For example, future researchers may be able to assist settlements with aspects of the following, particularly where there are knowledge and/or experience gaps, or a personnel or funding shortfall:

- housing and infrastructure management and maintenance systems
- settlement planning
- planning for management/maintenance staff transitions
- development of settlement maintenance manuals
- house surveying
- use of housing and infrastructure lifecycles software
- technacy education: identification and facilitation of appropriate education and training to support technology activities in settlements
- technology assessment and choice
- design brief development
- development of pictorial guides (and/or DVDs) to local housing preferences for informing outside consultants
- assistance with grant applications for housing and infrastructure
- identification of ways that communities can engage with outside agencies about technology issues from their own perspectives – in other words, how to get a voice in technology choice
- pictorial summary for settlement use in communicating with outside agencies/consultants
- posters and video for promotion of housing issues

- creation of databases of housing and infrastructure information for settlement use, including training in its use.
- creation of settlement design teams for collaboration with consultants, possibly to work on new projects during the life of the project
- provision of a housing pack for householders, which may include toilet paper, light bulbs, fluoro tubes and starters, and sink plugs, in return for access inside houses
- for extended consultations, provision of a mini survey-and-fix for one hour or less to tighten taps, spouts and door hardware; fit new shower rose; unblock sinks and basins; check power points and fit bulbs.

It is not intended that all of the above returns-of-service would be delivered to each partner settlement; they are a list of possibilities, with specific services to be selected by negotiation in line with project resources and timeframes.

As a further contribution to community partnerships, there is scope to engage in technacy education activities in desert schools to support extension of housing and infrastructure lifecycles. The project teams could work with desert schools to design and implement learning experiences for children and young people to help them understand and interact with their housing and infrastructure systems in a technate<sup>14</sup> way. This could be facilitated by experienced technacy educators in research teams.

While some of these items may not be directly concerned with research needs, it is clear that participation with the community on these above return-of-service items is likely to contribute to overall research goals. The important aspect of the return-of-service approach is that the research activities may highlight the community's priority areas, to which a response can be developed.

## Validation of participatory methods

While any of the participatory tools described above can be pulled out of the tool box in response to the direction of local research, it is important that local feedback about the appropriateness of tools and overall methodology informs the Housing Stories approach. During 2005, Lifecycles researchers consulted with communities, settlement groups, government agencies and non-government organisations to gain feedback about the Housing Stories approach.

### Basis for validation

A working basis for validation was developed and applied:

- field notes of discussion of issues with relevant people in settlements and settlement organisations
- feedback given at time of formal presentations
- record of correspondence with communities
- ongoing permission to continue discussions with communities
- direct responses in interviews/discussions
- discussions about pilot activities
- agreements to sign Memoranda of Understanding
- feedback from non-settlement stakeholders and others with an interest in project outcomes.

<sup>14</sup> Capacity to interact with technology in its applied context: as per literacy/literate, numeracy/numerate, technacy/technate.

For the purposes of validation of our project, its outcomes and its participatory approach in communities, it is assumed that the overall body of evidence of the above factors is evidence of validation of the Housing Stories approach.

### Validation by communities and stakeholders

Settlement visits and follow-up discussions occurred during 2005 to validate the methodology.

These discussions have generally included the following content:

- an introduction to Desert Knowledge Australia and the DKCRC
- an introduction to the Lifecycles Project, and its importance
- proposed participatory methods
- an overview of return-of-service possibilities
- formal partnerships
- intellectual property issues
- feedback on and validation of the participatory methods
- community participation to be included as in-kind time to the project.

On balance, there was strong support in settlements for the Housing Stories approach. The detailed content of discussions, the identity of settlements visited, and the individual people consulted has been covered in project reporting processes, and will not be revealed in this public domain report.

In addition to community consultations, there was widespread consultation through various field trips, meetings, discussions and correspondence with non-settlement stakeholders and other bodies, which could potentially be stakeholders in future research. These include government agencies, Aboriginal agencies, non-government organisations and other DKCRC project teams. From these stakeholders, there was good, positive feedback about the participatory approach to the project.

## Part 4: New thinking for sustainable investment in desert settlements

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### Knowledge gaps, emerging learning and new thinking

Once fieldwork finished in the last quarter of 2005, the project's focus shifted to a reflective mode to:

- identify the knowledge gaps
- analyse emerging learning
- synthesise the experience into new thinking
- articulate key strategies for future research.

After the completion of final field research notes in January 2006, it became clear that the commencing assumption underpinning initial project deliverables was not conceived to reflect whole-of-systems thinking, but would have well benefited from it, in hindsight. The research faced a crossroads in its development that, on the one hand, could focus on only rolling out a computer model (another assessment management tool) and advocate cheaper unit house technologies as the main outputs for its stage two project proposal, or, on the other hand, it could extend the analysis to proposing some new thinking about desert settlements to re-orient the discourse away from a narrow, technical and financial accountability approach towards a broader approach. This section of the report moves from synthesis into new thinking that has emerged to provide direction for future research.

This new thinking is expressed in a series of Key Dimensions for Change, leading to a revised value proposition and strategic approach. These dimensions have substantial potential for the sustainability of desert settlements and economic and cultural investment in such settlements. These understandings have been derived through reflection on the research team's extensive prior experience in sustainable development projects in desert settlements, through discussions with funding stakeholders and through meetings with people in settlements and settlement organisations.

The Key Dimensions for Change are identified as follows:

1. Housing for Livelihood
2. Desert Settlements and the Triple Bottom Line Plus One
3. Investment Capacities for Sustainable Development
4. Desert Performance Standards and Technology Choice
5. Services as Settlement Functions
6. Local Values and User Feedback
7. Talent, Technacy and Deep Diffusion
8. Social Networks and Regions

Each key dimension involves a range of the identified capitals, operating across networks through socio-technical systems. Future research activities should consider the impacts of these key issues. (See **Part 5: A revised value proposition for desert settlements**).

## Key Dimensions for Change

### Housing for Livelihood

The housing process for many desert settlements is characterised by a degree of disconnection with processes of physical settlement development as socio-technical systems. Too often the house is seen as the technical, or at best a health solution to shelter needs, rather than as a central factor in supporting livelihood: to leave a footprint in the desert that lasts long into the future, that enables people to live well and maintain a level of health, safety, relevant education and security from which other activity, including mainstream economic engagement, can spring.

#### *A broader definition of livelihood*

A wider definition of livelihood is considered here; while participation in and engagement with the mainstream economy is a vitally important aspect of achieving sustainable livelihoods, the term is used to describe desired, productive, culturally based, on-country living practices as well.

The condition of housing, good or bad, is an indicator of the sustainability of a place. The capacity to maintain housing is mutually dependent on a fundamental capacity to pursue livelihood outcomes. Good housing can foster better livelihood and good livelihood can drive better housing management; systems theory calls this a virtuous cycle – a system with appropriate feedback reinforcing good outcomes. Unfortunately, the converse is more usual: poor housing cannot support livelihood, and poor livelihood outcomes drive down housing management capacity.

It is proposed that thinking about housing be oriented to a whole-of-systems approach where ‘house’ is seen as strongly connected to, and supportive of, broader settlement processes such as governance, education, resources and real work. Thus we propose a fundamental shift from traditional policy debate underpinning social housing in remote settlements, from the current archetypal housing question:

- How can we efficiently fund the most number of houses?  
to the alternative:
- How can we design a housing system that fosters, for its part, sustainable livelihoods?

#### *Obstacles to Housing for Livelihood*

This research has identified a capacity gap in the education of children and young people, where there is no support to participate in the technological life of settlements. This is discussed in detail later in this section.

Another gap in the technological life of settlements is the capacity to interact positively with housing – to personalise the house by use of affordable furniture and furnishings, and to make modifications to the fabric of the building (including maintenance) in order to impart a sense of ownership and a sense of place. This raises issues of access to know-how (and know-why), tools and resources, this was suggested in Seemann’s earlier research, as described in **Part 1: Research scope and response**.

Another very stark capacity gap concerns the inability of housing programs to allow meaningful and extensive local community participation in the delivery of houses. While this is often included as a goal of such housing programs, other imposed accountability issues (such as best practice project management) tend to exclude local people from participation, and by extension, from livelihood opportunities. We propose that the degree of participation in housing delivery,

associated with a livelihood intent, is not only a measure of traditional ‘skill certification’ in the labour pool, but equally and alternatively, is highly governed by the type of housing technology and assembly systems selected for the end-user’s current and intended developmental stage in local skill and economic capability. That is, innovative, quality housing technology systems now exist in the market, which, potentially, radically change the degree to which certain certifications of on-site skilled labour are required. Thus, innovative and appropriate housing systems permit a high degree of local livelihood engagement, while other historical and conventional building systems can both restrict local and regional employment potential and send housing investment out of the regions, returning it to building contractors in central towns, who were trained to deliver housing technology. Parnell (1995, 1998a, 1998b) has demonstrated that participation is difficult to achieve if livelihood outcomes are not central to housing delivery processes. The CHIP review (PricewaterhouseCoopers 2007) has shown that even in a major housing and delivery program such as NAHS, the inclusion of local people in the delivery process has been a comprehensive failure, even in terms of mainstream economic livelihood outcomes. We believe this is at least in part due to the skill type required by the housing systems selected. This issue, we suggest, signals a concern for any new housing framework if the opportunity to build livelihoods outcomes into housing delivery processes is not pursued on the basis of a better match between end-users, on-site assemblers and maintainers. The opportunity to better match innovation in housing with local engagement means creating real work, with real wages, and not just more technical training for housing systems that are not designed to be livelihood sustainable.

### *Housing for Livelihood: future research*

A livelihoods goal for housing is particularly important if the agenda to encourage private home ownership on settlement land is pursued. See **Investment capacities for sustainable development** below. There is a choice here: use the pressing necessity for housing as a principal means of creating livelihood, or risk repeating the failures of the past. However, to make the choice, further investigation is needed.

### **Desert settlements and the triple bottom line plus one**

Current sustainability thinking in mainstream businesses, governments and civil society organisations is crystallising around the concept of the Triple Bottom Line plus One (TBL+1), where activities and projects are assessed and implemented in terms of sustainability in environmental, economic and social domains (Vandenberg 2002). The ‘plus one’ is a recent addition that seeks to also include performance measures of good governance.

Many local governments in Australia are implementing TBL processes: for example, the City of Melbourne, Blue Mountains City Council and Coffs Harbour City Council (2002). These processes can potentially map across to development processes and remote settlement governance.

### *TBL in the desert*

There is little evidence of this thinking informing the development of remote desert settlements. Sustainability is not evident in the conveyor belt approach, even though economics is the main driver of the delivery process, and social housing is the aim; the fact that housing is falling off the end of the conveyor indicates an unsustainable situation.

While there is a social dimension to the current housing and infrastructure delivery process, it is not being considered in terms of social sustainability, particularly in terms of local values and cultures, their capacities and their connection to housing and infrastructure lifecycles.

There is substantial focus on the connection between environmental health and infrastructure, but the ‘iron lung’ approach, as is often used, is producing unsustainable outcomes. The perception is that better technology is needed for environmental health problems to be solved. The lack of integrated sustainability thinking via TBL processes means that whole socio-technical systems are not considered in interventions.

TBL only drives processes to sustainability if the three factors of economy, environment and society are linked meaningfully. This is not the case in desert settlements. However, sustainability for Aboriginal settlements is being considered as part of the Western Australian State Sustainability Strategy, through the establishment of Regional Indigenous Sustainability Strategies (Kinnane 2002).

### *Desert settlements and the triple bottom line: future research*

The lack of connection of housing and infrastructure delivery processes to sustainability and the triple bottom line is a major inefficiency in the process, and should be further investigated.

### Investment capacities for sustainable development

#### *Investment capacity gaps and the development of Lifecycles software*

In the **Dimensions of housing and infrastructure need** section in **Part 1: Research scope and response**, the issue of the funding shortfall was highlighted. The existence of the shortfall is the major driver for this research investigation, as funding agencies are looking for new ideas to reduce of the shortfall.

The nature of the shortfall is, in reality, a gap in investment capacity. The development of appropriate web-based Lifecycles software tools is a key part of the strategy to understand investment capacity gaps and to make decisions about ways of closing the gap through productivity gains.

However, the principal component of the investment capacity gap is that the capacity and willingness by government (on behalf of the taxpayer) to fund housing and infrastructure is limited. There is also no clear intention or undertaking, even in the new housing framework, to fill the shortfall gap with current public funding regimes. The recent increase in funding for Aboriginal housing, though welcome, is likely to be too little to close the gap. Consequently, it remains unclear if public funding may seek to address the social component of the triple bottom line in a sustainable way.

#### *Linking investment to lifecycles and lived experience*

There is also no coherent way that government links upfront capital investment to ongoing maintenance and the regimes of maintenance – certainly not one based on lifecycles and the actual situations in remote settlements (Hall & Berry 2006). While the development of new lifecycle strategies, including software tools, is part of this research, one area not mentioned in any discussions or literature is to look at the investment capacity gap in an alternative way. Given the shortfall in need and the actual amount of funds available for remote settlement housing, what innovative and appropriate housing technology could actually be delivered to house all those caught in the shortfall gap, plus be maintained over an extended period beyond the eight years discussed?

While good lifecycle modelling can help make inroads into the shortfall, its potential effect is limited by the insistence on funding conventional housing models adhering to the Building Code of Australia (largely assuming access to services and condition of urban economies and geography rather than to remote desert standards), which typically requires an upfront investment of \$250 000 to \$350 000 per house, and often more, in remote desert settlements.

### *Net present value analysis and investment capacity gaps*

It is clear that current housing and infrastructure funding regimes are not subject to a net present value analysis that relates different lifecycle horizons to capital costs and various maintenance regimes to determine what is the realistic amount that should be invested in a 'housing' unit upfront. This is an important question to answer, because, given the finite amount of money being allocated, an insistence on conventional housing types means that a great number of others are condemned to no housing at all or traditional self-built wiltjas or shelters. Which way is it to be?

### *The offsetting value of Aboriginal settlements to Brand Australia<sup>15</sup>*

This research project has also investigated another alternative view of the investment capacity gap, connecting it to the economic justification for funding remote settlements (as opposed to a social justice/rights-based justification). This concerns the value to Australia, as a whole, of the mere existence of desert settlements, particularly in terms of the use of Aboriginal culture as a tourism-marketing masthead of Brand Australia. Initial research has indicated that the existence of traditional peoples has substantial economic value per se, and that this value should be incorporated into the investment gap balance sheet against the costs of development of desert settlements (Carson 2005). That is, from a net value account, what is the cost to Australia's economy and ecology if the desert was largely emptied of human settlements except for the few specific, isolated sites for mining and successful pastoral locations? Further work needs to be done in this area.

### *Investment capacity gaps at the settlement and personal level*

Another aspect of the investment capacity gap is related to the capacity of settlements and individual residents to fund, in real economic terms, their own investment in building. There are current discussions about issues pertaining to private ownership of housing on communally owned land, but the endemic incapacity of many desert people to pay minimal rents or service fees far below the real capital costs of investment and the real costs of maintenance, indicates that there is a huge capacity gap between the standard of housing in desert settlements and the capacity of people to contribute to the costs of such housing (Altman, Linkhorn & Clarke 2005).

### *Investment capacity and private home ownership on communal land*

Much recent discussion in the media and by governments, politicians, stakeholders and commentators has identified the lack of private ownership of property as a major factor holding back the development of remote Aboriginal settlements and their inhabitants (Cleary 2005; Hughes & Warin 2005). Essentially, such arguments proposed that a defining factor driving economic growth in Western countries is private ownership. Private ownership allows people to leverage equity in property for entrepreneurial and other developmental goals and aspirations. The argument further proposes that the communal ownership of land in remote Aboriginal settlements is a barrier to individual enterprise.

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<sup>15</sup> Brand Australia in this section refers to the opportunity cost to Australia of overseas investors if the outback was, in theory, emptied of Aboriginal settlements and culture along with 4WD routes, national security and images of our outback.

This is a little explored area in the context of the remote desert settlement, and like many mainstream prescriptions and solutions transplanted across space and culture, there is potential for success or disaster. Thus further research is needed to determine the extent to which a policy shift towards more private ownership of desert housing will result in the extension of housing lifecycles.

There are two fundamental assumptions regarding the impact of a policy shift towards modes of housing and services that encourage greater private ownership and government–settlement partnerships. These are that:

- such a policy shift will extend the lifecycle of these technologies, in turn reducing costs to government and householders
- technologies will provide enhanced amenity as a consequence of design, maintenance agreements and financing that accord with householder needs and capacities.

Such a policy shift also implies the following conditions are present:

- end-users have access to appropriate educational services and low-income models of financing that support an owner–occupier and/or micro-financing model of housing and technical services (CLC 2005)
- government agencies associated with housing and infrastructure programs are able to deliver flexibility with respect to community and user agreements for design, servicing and levels of financing
- cultural perceptions of land ownership and stewardship found in desert settlements can be harnessed in support of responsibility for individual and settlement infrastructure
- views of men and women are brought into decision making regarding infrastructure planning, design and management
- end-users and settlement leaders have the capacity to negotiate and honour contractual agreements
- local people will not perceive this as a means of extinguishing native title (Pearson 2005).

### *Investment capacities: future research*

The research proposed therefore explores the extent to which the assertion that a policy shift towards privatised desert housing and improved government–settlement partnerships in infrastructure service models, and the community educational demands that are implied, will result in extended lifecycles of technologies and technical services, and the sustenance of greater amenity for households. This should be a key consideration in future research.

So, given these two investment capacity gaps, and the questions raised above, is the government monopoly on supply and the imposition of mainstream rules and standards on the type of housing and infrastructure a sensible, effective, accountable and ultimately sustainable way to proceed? Does private ownership hold any promise for closing the investment capacity gap? How is the funding of remote Aboriginal settlements offset against the value of these settlements to Brand Australia?

The next stage of the research should explore this issue in depth, from both the supply and demand sides.

## Services as settlement functions

### *Supply-driven or demand-driven services?*

A key area of discussion about the sustainability of desert settlements concerns whether services to settlements should be supply-driven or demand-driven. This delineation may pre-empt a deeper discussion about the nature of services, what services are meant to achieve and how services flow through settlements, particularly in terms of community feedback processes.

### *Settlement functions*

The material assets in the economy of small and usually sparsely distributed settlements of desert Australia, develop largely from supplied systems, structures and devices required to support settlement functions. They represent an expression of the activities important to the various communities occupying a human settlement and are usually determined by a standards-driven supply agency, or a locally perceived view of demand given to the supply agency. These settlement functions may be regarded as interchangeable with the notion of services to and within settlements.

Seemann's research investigation (1997) of over 34 remote Aboriginal settlements, mostly in arid regions of Australia, identified that services (or settlement functions) are best understood as comprising inseparable social and technical couples: interdependent entities that are termed socio-technical events and activities. Accordingly, all services are understood more comprehensively this way, and this understanding will better inform the management of the service or function.

Best practice in managing all services and assets is conceived as always involving both social and technical drivers that ought ideally be designed to function together with the general goals and economic contingencies of the settlements.

### *The demand-driven approach is problematic*

Discussion of supply-driven or demand-driven is based on notions of markets, whether free markets, regulated markets or market failures. When applied to desert settlements, the discussion of demand-driven or supply-driven services takes the language of the market economy without necessarily analysing whether the substance of the market economy is plausible in such settlements.

There is often an expressed assumption that ideas of consulting desert people about their needs is equivalent to a demand-driven approach, but this may be an erroneous assumption. Demand-based systems assume competition in supply, not government monopoly, as is the case currently. Demand-based systems also assume that people have the economic capacity to back up their demand. In a welfare-based settlement development system where government agencies, through benefits, provide money to people to buy services which are, in turn, funded by government agencies (often the same agencies), is it realistic to talk in terms of demand-driven delivery, in a whole-of-systems sense?

This government-centred approach may be considered as wholly supply-driven, even if people are consulted at some stage of the process. This approach does not appear to map across to the notion of demand in a market economy.

Another assumption of the demand-driven approach is that people fully understand their own situation and know exactly what will meet their needs and how their needs should be met. Thus, in this view, people are well placed to demand services appropriately. While it is true that sometimes simply asking people what they want leads to better outcomes (and is certainly better than ignoring

or excluding people), it is a leap of logic to assume that people have the capacity to make informed decisions about services, especially where there is a degree of complexity involved, and where substantial educational disadvantage may have defined their histories.

### *Services as settlement functions: further research*

This research challenges this assumption, firstly by re-orienting discussions about services around settlement functions (or goals), and then identifying the role of individual and community capacity and capacity development in decision-making about services. Then, we may be in a position to discuss the pros and cons of demand-based versus supply-based service delivery, and perhaps to abandon such delineations in favour of a ‘consequences-based’ service delivery.

Given the importance of this discussion in determining service delivery processes, the next stage of the research should engage in a mapping process to see if demand-driven delivery, as understood in the market economy, is an appropriate fit in the welfare-driven process of settlement development; to investigate the distinction between services per se and settlement functions; and, finally, to investigate capacity issues relevant to service delivery.

## Desert performance standards and technology choice

### *Technology choice*

Technology choice has emerged as a significant dimension for change, and it cuts across many of the other identified dimensions. Technology is not seen in this research as merely a collection of physical hardware; with the framework of socio-technical systems as a guide, technology should be seen as a dynamic social process. It is deeply connected to the key dimensions of **Services as settlement functions**, **Local values and user feedback** and **Talent, technacy and deep diffusion**.

While design and quality of resources and technologies such as houses and their components are very important and form an excellent basis for local discourse and learning, their value in terms of their sustainability is mostly determined by how they are managed and the assumptions of contexts under which they are supplied. This issue includes consideration of whether policy and standards facilitate locally informed and expressed choices and defined risk management, or, instead, whether they result in the funnelling of choices towards ‘policy compliant’ but unsustainable assets, or technology capacity development training programs that are unsustainable.

It is apparent that settlements, or agencies working on their behalf, regularly make habitual choices about technological prescriptions to meet community goals and needs, either through haste, disempowerment, minimal choice opportunities, lack of understanding of their own goals, lack of understanding of technological impacts, or an equity-based desire to have what others have rather than what is most appropriate for their present situation, which may include their plans towards expressed aspirations.

Technology, too, should be seen as a form of service delivery, which should ultimately meet settlement function. Often a particular form of hardware is seen as meeting the need, for example, the fully funded three-bedroom conventional house as the only technical solution to living well on country.

Making good technology choices, particularly the choice not to use a particular form of technology, is a complex activity, requiring access to information in combination with higher-order ways of knowing, and is intimately linked to individual and community capacity. Good technology choice often involves a process of un-learning assumptions about technology/function match-ups, and re-examination of individual and community goals and needs.

### *The value of technology innovation and design*

Of course, the research is not devaluing the impact of technological innovation and design-driven solutions. Innovative technological interventions have the potential to extend house lifecycles while improving amenity for desert people, and should be pursued (FaCS 2005). However, technological intervention and design-driven processes are the ‘low-hanging fruit’ in the systems viewpoint of sustainable settlement development. Improved and innovative hardware may bring about a percentage improvement in liveability and lifecycle, but this will contribute substantially less than innovation in whole socio-technical systems.

### *Desert performance standards*

As indicated above in **Investment capacities for sustainable development**, technology transfer in remote settlements is driven by codified values and standards which concentrate available funds around mainstream technological standards. The outcome is that many people miss out completely. By challenging conventional standards and allowing for revised standards commensurate with the living practices and capacities of desert people, more settlement functions can be mediated by technology choices by promoting a greater spread of available funding.

### *Desert performance standards and technology choice: future research*

This research proposes further investigation into how desert people make technology choices around physical settlement development (or not, as the case may be), and how they interact with the technology they have in order to achieve their self-perceived goals and needs. We also hope to develop guidelines to help settlements and funding agencies to determine what standards are appropriate through the development of sustainability indicators to guide investment processes and choices of design and development standards. As an initial proposal, such indicators could be developed in the following areas:

- social
- educational – including curriculum and access K–9
- climatic
- economic and cash flow
- resource availability and flow
- technological.

### Local values and user feedback

#### *Intersecting value systems*

This research emphasises the importance of the local view of housing and infrastructure (Hansen & Roche 2003). Experience with physical settlement development in desert settlements indicates that the living space is where two quite different value systems meet: the values embodied in the mainstream notions of ‘house’, for example, and the values expressed by desert people in their everyday usage of housing and its related infrastructure. The technology of the house, particularly the funded, standardised, codified version, has an embedded culture of funding, design, construction, usage and maintenance. For desert people, this embedded culture is not always obvious, acknowledged and valued, with substantial discontinuity in understandings of how to manage and maintain their housing (Pholeros, Rainow & Torzillo 1993).

This meeting of values is a fundamental reality, often obscured or ignored by the process of productively delivering housing units for the lowest up-front cost. This research recognises that the place of intersection of these value systems is where both the problem of existing short housing lifecycles and the opportunities for extending housing lifecycles lie.

### *User feedback*

The supply/demand dichotomy loses meaning when processes are viewed in a whole-of-systems sense. Systems always include some form of feedback, whether intended or not. Currently, most feedback in the housing system is largely about technological failure. Bringing a local values enquiry into the process introduces another systemic feedback loop with potential to more appropriately orient housing systems towards better socio-technical outcomes. A number of investigators have called for local values to be included in housing and infrastructure evaluations (ANAO 1999; Fletcher & Bridgman 2000; Spring 2005)

### *Local values and user feedback: future research*

A participatory monitoring and evaluation approach has been proposed (Guijt & Braden 1999; McAllister 1999) because it increases the chances of obtaining a fuller picture of what value people place on their housing, their usage behaviours and critical events that impact on the life of housing. From the start, this project has sought the opinions of the local people. Future research should prioritise activities around participatory monitoring and evaluation approaches.

## Talent, technacy and deep diffusion

### *Talent investment*

Local talent and capacity gaps are a focus of this research, and arguably impact across every activity in desert settlements. Fundamental talents to both acknowledge and enhance include:

- literacy, numeracy and curriculum relevance
- technacy
- health and wellbeing
- investment and livelihood
- governance and management
- social capital
- personal wellbeing (such as motivation and self-esteem).

The Lifecycles team has considered how these gaps connect to sustainable investment in desert settlements, and most of the above are included either directly or indirectly. Some areas, such as the health gap, have been dealt with through the incorporation of housing standards pertaining to design issues and hardware specification. While the governance gap is being dealt with through other DKCRC projects, a deal of settlement governance issues are directly or contextually related to the housing and infrastructure domain. Consequently, the Lifecycles team feels that it can best approach the governance gap through its holistic systems-style approach relevant to housing and infrastructure governance, with emphasis on the technacy gap. It is also considered that any improved software-based management tools are reliant on local capacities: sophisticated tools require a sophisticated capacity to extract value.

### *Access to education*

A fundamental question in any discussion about capacity development is the availability of education and training. For many desert people, they are further disadvantaged by the lack of educational opportunities, as shown in the statistics for delivery of educational programs. A recent report (Guenther et al. 2005) highlighted access issues, concluding:

*Access to education services across the desert is relatively poor, especially at secondary and senior secondary levels.*

The report also identifies that even where education across the sectors is available (Guenther et al. 2005):

*Aboriginal primary school students are less likely to achieve year three and five literacy bench marks; Aboriginal students of secondary age are half as less likely to achieve year 12; and while Aboriginal students are participating at increasingly higher rates in VET their pass rates and qualification outcomes remain well below that of non-Aboriginal Australians.*

The implications of the above for achieving benefits from technacy programs are significant, particularly for the way such programs are planned and implemented.

### *Technacy gaps*

A review of prior research undertaken in the area of socio-technical systems in householder (social and physical) capital for housing maintenance in desert settlements was combined with current preliminary discussions and observations during the course of this scoping stage, and helped to shape the conceptual framework for the research. (See **Review and analysis of prior socio-technical systems research.**)

This review affirmed that desert settlements have a complex, cause–effect pairing of social and technological factors that affects the condition status of houses in their context (Seemann 1997). This review highlights the need to rethink early educational priorities in schools towards more generic project- and design-based learning in various technologies and to rationalise services to housing sufficiently to reach a local critical mass of relevant talents, householder tools and resources (for minor ‘do it yourself’ DIY household improvements).

The research has found a major capacity gap in most isolated small desert settlement schooling at two levels. At the first level, most educational services stop for most desert children after around 11 to 12 years of age, not to be re-engaged until early vocational education is considered at around 16 years of age. By this time there is a very small likelihood of uptake and completion in further education. Secondly, the time spent at primary school in many cases barely dedicates time to fostering technacy capacities, let alone locally interesting and engaging learning. The seriousness of this gap, in both engagement and in content, affects a community’s capacity for managing, choosing and engaging in a contemporary material culture and economy in their region. This contrasts with more urban and coastal education experiences where settlement media in DIY lifestyle programs, design and technology (technacy) education curriculum and social norms are rich and contiguous, and result in a well-established, ‘growing up’, socialised understanding of many ordinary and new technological knowledges and experiences resulting from choice.

### *Talent and deep diffusion: future research*

Capacity development is often discussed in a very prescriptive way, that is, in terms of accredited training and formal education. While these factors are important, and their impacts need further investigation, there is a need for a ‘deep diffusion’ of technacy principles, not only at the knowledge level, but also at the cultural level, across all age groups.

The key factor of successful technacy-based talent development is the degree to which the knowledge has been internalised, new cultures have developed around the new knowledge, problems are solved and settlements become adaptive to changing situations. This can only happen through deep diffusion of technacy over long timeframes.

This research has identified the need to address research in technological problem-solving as a contributor to emerging capacity development – particularly the development of generic understanding and skills in creativity and innovation for working through technological ideas and projects as a normal and engaged ‘growing up’ experience for locally relevant desert settlement education.

Research activity should be prioritised to assist and explore, over the long term, the development of critical capacities in choosing, valuing, problem solving and skilfully applying technology to meet human needs, that is, to fostering technacy alongside literacy and numeracy skills as core curriculum.

The next stage of research should address the issue of capacity development through institutional, informal and creative delivery of technacy education, focusing initially on the critical middle schooling years normally in the range of children from 10–14 years old.

### Social networks and regions

#### *Ekistic thinking*

Much of the thinking and issues discussed in this research concern the discrete settlement, which is classified as a shell and as small-scale in the ekistic framework. Ekistic thinking also identifies elements common to all settlements, which includes nature, society, networks and culture, in addition to shells.

Using the lens of ekistic theory, remote human settlements can be understood in terms of society, networks and cultures, and not just discrete places. Settlements feed back to human community groups in ways that affect the functionality of those groups. Similarly, various human community groups use and associate with a network of settlements. Accordingly, ‘towns’ are in fact part of a wider network of settlements and in sparsely located regions of settlements, the local network cluster of towns, particularly as defined by communication, cultural and transport links, may potentially work together rather than in isolation provided that the cluster makes social and local sense to its members. Indeed, this viewpoint appears to map well with Aboriginal perceptions of place, space and relationships to country and culture if defined appropriately.

If, as indicated in the key dimension of **Services as settlement functions**, it may be useful to conceive of services as settlement functions emerging from community goals, then the idea of networks and regions, rather than discrete settlements, may have value as a template for sustainable development.

Some regionalist thinking has informed service delivery processes, particularly in Central Australia. However, this is strongly tied to up-front, supply-side efficiency in delivery of services, rather than creating greater flexibility in terms of the society/network/culture aspect of contemporary life for desert people.

### *Re-conceiving remote settlements*

The management of physical assets is key to the process and includes choice, understanding the social and organisational demands required to construct or maintain the assets, cost of assets and knowledge of alternatives. Further, the thesis supports a position that, while small remote settlements are classified as discrete settlements in terms of how transferred technologies and local economic activities are evaluated and serviced, there remains a limit to the degree those settlements in the smaller end of economy and population can support transferred technologies. This means that, apart from more sustained cash investment into these settlements, often the only option of substance for long-term functionality and economic development is a choice between migrating to larger urban centres (which presents new issues) or reconceiving the classification of remote settlements as networks; the latter can offer new ways forward worthy of consideration and further research.

### *Social networks and mobility in regions*

Social networks, as indicated previously, have a strong correlation with mobility of desert people within and between settlements (Guenther et al. 2005; Mitchell et al. 2005). Mobility, as a deeply expressed cultural value, is a 'given' when discussing development in discrete settlements. Yet processes of settlement development are framed as if this either did not exist or was an irrelevancy. The form of technology delivered to settlements comes from a cultural basis of stability in mainstream residential areas, not from a mobility-based culture.

With mobility as part of the culture of desert settlements, some commentators have identified that in some cases, mobility is more increasingly one way: from outstations to larger settlements, from larger settlements to the regional towns, in a form of out-migration of desert people seeking services and amenities not available in their remote settlements. This research has not yet identified whether this is a significant one-way effect, or just part of the moving from place to place that has regularly occurred. It is important to determine whether the effect is significant and whether it is a counter-balance to the population growth among discrete desert settlements arising from lower infant mortality rates. Understanding whether an out-migration effect is at work is critical for developing strategies for sustainable investment in desert settlements.

### *The new political agenda of shutting down settlements: the economics*

Finally, not waiting to see if out-migration is observable, some politicians and media commentators are promoting the idea that remote settlements are unviable and unsustainable, and that desert people should be located to larger settlements and the main regional population centres. The rationale is that services are easier to fund and deliver in regional centres. Think tanks, such as the Centre for Independent Studies, are taking a very aggressive position in relation to the viability of remote settlements (Cleary 2005; Hughes & Warin 2005).

This point of view, as it has been expressed in the media, is largely polemical, possibly racist, and has not been subjected to economic analysis. In fact, it is not possible to make a judgement about the issue without being able to analyse lifecycle costs of different settlement, regional and network-based options, with the full costs (both direct – housing costs, and indirect – the social costs of sudden increases of population and cost-shifting, generally) factored into the analysis.

### *Social networks and regions: future research*

Rethinking that widens the footprint for any one settlement to a cluster of settlements, including a virtual cluster of settlement networks, may open up new economic and regional/cluster service opportunities and innovative solutions. The solutions may well take advantage of new telecommunication technologies and policy shifts in the notion of both rethinking standards for technologies and services and for rethinking the K–9 educational curriculum for developing capacities in creative technology and design.

Future research should investigate the effects of networks and regions (including the impacts of mobility and out-migration, if any, and re-location proposals) to help shape decision-making about the nature of development of discrete desert settlements, and to promote transparency.

## Part 5: A revised value proposition for desert settlements

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This research has proposed that socio-cultural, educational, economic, technical and climatic factors combine to form complex cause–effect patterns that affect the life of housing and housing service effectiveness in settlements. As such, this research seeks to account for the main contingencies and relationships inherent in housing services (as a service cycle), and quantify, where possible, the whole-of-life costs and time implications to distil the main ideas that would have the best chance of improving housing services to sparsely distributed desert settlements.

Physical capital comes in with embedded values (technological, financial and social) necessary to optimally manage that capital, and these things are generally not well understood by mainstream society, let alone people in desert settlements (Walker 2006, p. 15; Seemann 2006, p. 288). These embedded values run deep and are not adopted by desert settlements in a short-term program sense. This incapacity to understand and operate technology according to its embedded values is a major capacity gap, which can only be bridged by deep cultural change at the interface between the traditional world and the technological society.

Such appreciation of the social dimension to technology choice will not solely occur through a piecemeal approach of technical training, best practice housing delivery, more and better tools, software development and application, or, indeed, threats to remote settlements concerning their ‘unviability’. It is likely to require a joined-up, core commitment of relevant housing, educational and resource agencies in collaboration with the settlements.

### Revised value proposition

A significant learning from the scoping process is that change for sustainable investment can be driven by:

- making Housing for Livelihood a central goal of any housing delivery system
- innovation in design and technology, including rethinking of desert standards based on triple bottom line performance briefs
- improved delivery processes
- improved settlement and regional management systems
- better management tools, such as lifecycles software
- more and improved technological education and development of problem solving, communication, and project management skills rather than more conventional technical skills alone
- more and improved access to physical tools by the householder
- more local participation in development processes and hardware management knowledge.

However, analysis of the above drivers indicates that their overall potential may well be reliant upon human capability across settlements. Accordingly, this research is anticipating that the key dimension of **Talent, technacy and deep diffusion** has the greatest potential to not only bring about measurable change, but to connect the other dimensions for change as a coherent and sustainable base for future investment and supporting livelihoods. This, then, leads to the following revised value proposition:

*That the most cost-effective and impacting extension to the life of the physical capital of remote desert settlements and to the improvement of the sustainability of investment is in the introduction of technacy education in the K–9 curriculum in desert regions, encompassing the cultures and values embedded in technology, making informed technology choices and supporting inventiveness both at home and in meeting settlement functions.*

This value proposition is supported by a set of Keystone Strategies, as outlined in the next section.

## Keystone strategies

This section of the paper proposes the direction of future research, ideally site based trials, based on the revised value proposition and identification of Keystone strategies to bring about change.

These Keystone strategies have emerged from the review of the socio-technical elements involved in sustaining settlement functions, understanding ways forward in enhancing the value of material assets, and contributing to sustainability in desert settlements. They connect to the issues raised previously in **Key Dimensions for Change** and are summarised below with accompanying notes to facilitate future research design.

### Keystone strategy 1

<p>Housing for Livelihood: make it a central goal of any housing delivery process</p>	<p>Creating opportunities for local people to fully participate in the housing delivery process through real jobs will have major livelihood benefits and contribute to increasing capacity for desert people to manage, modify and interact with their housing, provided the housing technology used enables appropriate levels of engagement.</p>
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### Keystone strategy 2

<p>Bringing triple bottom line plus 1 (TBL+1) thinking into the development process</p>	<p>Investigating ways to integrate economic, social and environmental issues with governance goals will see better matches between resources, capacities and outcomes.</p>
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### Keystone strategy 3

<p>Closing investment capacity gaps</p>	<p>To better understand alternatives to urban standards-based investment, apply Lifecycle analysis to investment capacity gaps to help guide decision-making about funding, standards and local investment capacity. The development of sophisticated Lifecycle tools is part of this strategic response, along with consideration of the economic value of the existence of desert settlements.</p>
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### Keystone strategy 4

<p>Developing desert performance standards</p>	<p>To make some real progress in the desert, certain assumptions in current policy and standards require a rethink so that providers and beneficiaries may more flexibly facilitate locally informed choices and locally defined risk management standards.</p>
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## Keystone strategy 5

<p>Servicing human networks and human settlements together</p>	<p>It's more about management, talent continuity from an early age in technology and design, and rethinking the assumption that 'desert people live in discrete remote settlements'. It is also a question of understanding how notions of demand-driven versus supply-driven map to the realities of a welfare-oriented, community development process in many locations.</p>
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## Keystone strategy 6

<p>Understanding local values</p>	<p>People in desert settlements live according to their own value systems, which are usually opaque to those delivering housing and infrastructure. The approach to development must adopt a truly participatory approach that allows people to tell their stories about the realities of living with settlement development policies and decisions, and for those stories to influence the development of lifecycle tools and policy decisions. Further, imposed policy prescriptions, which are incongruent with local values, have a reduced chance of success.</p>
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## Keystone strategy 7

<p>Turning around under-developed local talents in technologies and innovation</p>	<p>One of the greatest potentials for improving the lives of desert settlements is to substantially strengthen technacy in K–9 education, using new educational technologies and promoting local attitudes and interests in being innovative in the emerging material and digital economy* from an early age. In many remote Aboriginal desert settlements, the current literacy and numeracy focus could be enhanced if it were turned on its head and driven or supplemented by technacy education which seeks to foster creative and contextually applied problem-solving skills in design and technology.</p> <p>* The increase of new industrial methods and resources as well as new digital devices underpinning economic drivers, and so new demands on learning and understanding them.</p>
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## Keystone strategy 8

<p>Extending lifecycle analysis from settlements to regions</p>	<p>It is not possible to understand the impact of regionalism and regional networks, let alone to make coherent decisions, without the capacity to understand lifecycles. The research will develop and apply lifecycle tools to understanding some of the ideas about settlement viability, especially those involved in out-migration and relocation of desert people.</p>
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## Synthesis

### An emergent scenario for further research – both ends of the conveyor?

There has been recent and increasing public discourse about the state of Aboriginal housing, especially for remote desert settlements; such discourse is often connected to recent revelations in the media about the extent of domestic violence and child sexual abuse in remote settlements. This has sparked a flurry of policy activity, which is fast re-shaping the landscape for housing and infrastructure delivery by introducing new Federal Government policy proposals for housing and infrastructure.

This research has been substantially based on the process whereby much Aboriginal desert housing is handed over to settlement control or, alternatively, while nominally under outside control, is often outside the capacity of service regimes to deliver efficient, timely and economic maintenance. Both scenarios result in reduced housing lifecycles and livelihoods.

These new policies appear to be taking the responsibility for housing management away from settlement control and redirecting the responsibility to governments, territory, state and federal. In other words, the Federal Government appears to be positioning itself at both ends of the conveyor. It is not clear from this recent public discourse whether the implications of this policy change has fully accounted for whole lifecycles. It does appear, however, that desert settlements have been held largely responsible for current system failures and capacity gaps. This may be politically sound, and populist, but if this is taken as fact, then there may be a tendency by government to ignore many of the mitigating socio-technical circumstances pertaining to desert settlements, which, if not accounted for in the new policy framework, may still bring about outcomes on par with the current situation.

The Lifecycles research to date has not factored in this change as a scenario, and it has been difficult to accommodate the new policy landscape at the end stage of this scoping study.

However, the research team has considered the potential impact of the proposed changes and identifies that the recommended Keystone Strategies remain a relevant and vital imperative. It is possible that the main impact of the proposed changes is that the investment and technacy capacity gaps will have migrated to different parts of the encompassing socio-technical system. Many of the problems, especially of remoteness, will still be present; will create technical, administrative and economic difficulties; and will create substantial lifecycle impacts.

Further, the changes proposed will not take into account the impacts of user behaviour and the local context. Local capacity gaps will still impact considerably on the housing and infrastructure process.

A centrally managed, supply-side housing and infrastructure system raises many questions, which should be included in the next stage of research:

- On what basis will government make decisions about allocations for capital investment and maintenance if no lifecycle analysis is done?
- If government manages the whole process, how will it deal with the contextual difficulties of remote settlements when the lack of local capacity can no longer be blamed for poor housing performance?
- Will the one-size-fits-all approach become more widespread, and, if so, how are local contexts to be accommodated?
- If housing is delivered into contexts where the end users have difficulty living with or engaging with it, then what impact does this have on increasing the cost of the maintenance regime where it is solely supply-driven?
- What would be the secondary effect of removing a potential source of income from an already small and fragile economy that would otherwise depend on such opportunities? A scenario could emerge where, effectively, supply yields a diminishing economy and no livelihoods opportunity.
- What are the prospects for creating a level of outside, supply-driven capacity (management and skills) to do the maintenance work more effectively than at present, and in a way commensurate with the increasing scale of the delivery cycle? Are there enough skilled outsiders willing and able to do the task?

- Will the housing system include furniture and whitegoods and other fittings to make housing liveable?

These questions are only an initial proposal for further research, as more information and policy delivery will occur over the coming months. The bottom line is that the new proposals will have an economic and social impact, positive and/or negative. Any negative impacts of the proposed policy changes are not part of current public discourse; there is a strong possibility that the new policy prescriptions are being made without understanding the whole system. The impact of the new proposals must be assessed in the next stage.

### Embed participatory processes in the research.

This report has outlined a broad participatory approach to mapping the values, attitudes and priorities of Aboriginal people for housing and infrastructure in remote desert settlements. Arguably, for the first time in Aboriginal Australia, desert people are invited to evaluate the outcomes of housing and infrastructure programs according to their own perspectives, if these recommendations are taken up. The approach primarily seeks to create time and space, in a culturally sensitive way, for people to tell their stories about housing and infrastructure.

It is important that future research has adequate funding to allow the process described in this report to occur without compromising the ability to slowly and sensitively allow the stories to emerge. There will need to be regular settlement visits by the research team, with associated costs, but, more importantly, the engagement of Community Researchers will be central to success and should be treated as a substantial contribution to the research effort – token involvement for pocket money will be unacceptable. To foster the development of a new career path for settlement people as Community Researchers, a retainer or wage must be paid to them so that they can give regular attention to the issues in each settlement. This is important to enable the research work to fit in with other employment activities in settlements, so that it is seen as an active part of the working life of the settlement.

In order to justify the effort to set up and carry out a Participatory Monitoring and Evaluation process, it is vitally important that desert peoples' housing stories contribute to shaping the development of new lifecycle models, new housing delivery processes and housing-for-livelihood. How this connection will be made is open to question – translating stories into data, and into a system for organising data will be a major challenge for the modellers. Behind realistic lifecycle modelling are the real stories of real people.

### Validate processes with settlements

Through extensive consultation with a wide variety of people in remote Aboriginal settlements, Aboriginal settlement organisations and other stakeholder groups, this report clearly demonstrates that there is substantial support for the research and the Housing Stories participatory approach.

The participatory approach has been extensively documented and has been designed in response to the problems experienced by previous housing and infrastructure evaluations.

Aboriginal people in settlements appear to appreciate the long time frame for the project, and that they will not be rushed into telling their stories.

The offer of return-of-service for access and information has been well received and it has been contrasted against other survey-based methodologies that take, but don't give. Aboriginal people are seeing that there are potential benefits for their settlements in both the short and long term.

In particular, Aboriginal people are pleased that local people could be employed as Community Researchers, that Community Researchers can be involved in designing settlement-based activities, that activities can use visually based methods, and that research activities can contribute to local people solving pressing problems in settlements.

## Conclusions and recommendations

This report set out to review and reflect on the work to date by starting to synthesise emerging understandings, to articulate new thinking in relation to these understandings, and to develop Keystone Strategies for exploring the new ideas in the next stage of research into sustainable investment in desert settlements.

By using the theoretical frameworks of the Total Capital Model, Socio-Technical Systems, Ekistic Theory and Technacy, the Lifecycles research team has embarked on a series of research actions, including establishment of the project and PhD candidatures, review of housing data and systems, commencement of fieldwork and relationship-building with remote communities, validation of proposed field methodologies, analysis of data for lifecycle model development, synthesis of findings and revision of the project's value proposition.

As part of the analysis of research findings, some key dimensions for change were identified:

- Housing for livelihood
- Desert settlements and the triple bottom line plus one
- Investment capacities for sustainable development
- Desert performance standards and technology choice
- Services as settlement functions
- Local values and user feedback
- Talent, technacy and deep diffusion
- Networks and regions.

From the synthesis of these dimensions, the Lifecycles team developed a revised value proposition incorporating these key dimensions, but with the main focus being to connect these key dimensions for change into a more coherent whole, through the following contention:

*That the most cost-effective and impacting extension to the life of the physical capital of remote desert settlements and to the improvement of the sustainability of investment is in the introduction of technacy education in the K–9 curriculum in desert regions, encompassing the cultures and values embedded in technology, making informed technology choices and supporting inventiveness both at home and in meeting settlement functions.*

Arising from these key dimensions, the following Keystone Strategies are proposed as areas of activity for the next stage of research. The Keystone Strategies represent a considered response to the problems of physical settlement issues in remote desert settlements, and their whole-of-life dynamics. It is important that the strategies be incorporated in the next stage of research, and be appropriately staffed and resourced, over an appropriate timeframe, especially for participatory research at the desert settlement level.

**Keystone strategy 1**

Housing for Livelihood: make it a central goal of any housing delivery process

**Keystone strategy 2**

Bringing triple bottom line thinking into the development process.

**Keystone strategy 3**

Closing investment capacity gaps

**Keystone strategy 4**

Developing desert performance standards

**Keystone strategy 5**

Servicing human networks and human settlements together

**Keystone strategy 6**

Understanding local values

**Keystone strategy 7**

Turning around under-developed local talents in technologies and innovation

**Keystone strategy 8**

Extending lifecycle analysis from settlements to regions

It is strongly recommended that these Keystone strategies be at the forefront of future research.

The knowledge gained from this research has the potential to significantly influence housing and technical services policy, and settlement education policy. In addition, it will provide substantial insights into changes needed in the role and structure of government extension and education services associated with infrastructure programs in desert settlements, particularly in relation to understanding the systems requirements to deliver more appropriate and cost-effective technical services, education and housing technologies.

To date, there has been wide and strong support expressed by stakeholders and desert settlements for this research and the approach it is taking to comprehensively address the issues that affect and can improve the lifecycle of houses and associated infrastructure.

The main thesis of this project is that technical and economic considerations alone are inadequate for developing innovative responses to the expressed need. Key factors for success are local end-user experiences and the capacities of desert people in their social contexts, and how they can enhance technological decision-making, so as to extend the life of housing and enhance investment sustainability.



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