THE DEVELOPMENT OF A TYPOLOGY FOR REMOTE CONSTRUCTION PROJECTS

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Remotely located sites have become more accessible and therefore more valuable and profitable to investors and entrepreneurs. Typically these sites are environmentally sensitive. For the designer, these sites offer a unique challenge conceptually, in terms of the physical and cultural constraints. The built environment research community has yet to seriously take up the challenge of developing theoretical models for the management of the design and construction processes for remotely located projects. Such models would explore efficiency and efficacy management for projects in remote and often hostile areas, in an integrated and sustainable manner. There are varying degrees of remoteness experienced in nearly all construction projects and therefore a clearer definition of the characteristics of remote sites is required. Towards this definition, a typology is initiated for the concept of remotely located construction projects related to environmental sustainability and the management of the design process. The characteristics of the typology are drawn from a selected literature review of the fields of design management and environmental sustainability, and from an exploratory investigation of two case studies.

Keywords: design management, environment, remote site, sustainability.

INTRODUCTION

The design and construction of projects at remote sites is not a new phenomenon. For example, major infrastructure projects such as canals, dams, power stations, roads and bridges, oil and gas rig platforms, mines, tourist resorts, defense and scientific bases have been built for decades in remote areas. The emerging environmental movement in recent years, though, has focused worldwide attention on the need for sustainable development for these sites as opposed to the pragmatics of *getting the job done, on time and to budget*. For years, construction companies have built in areas distant from their home base and have taken a mainly logistical approach to these sensitive sites. The clients, and design and construction industry involved with developing these remote sites, have an increasing duty of care in a global sense, to these often-pristine environments and their ecosystems. Very little research in the past has considered theories related to this specific topic from the design and construction management perspective. The research community has yet to take up the challenge of developing theoretical models that explore the design and construction processes in an integrated

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and sustainable manner for these remote sites. It is suspected that the current design and construction management models do not address the unique aspects of these sites and neither do the sustainability models. The concept of remote sites refers to a number of different, and complex, dimensions and properties, and can therefore be developed in a categorical and comparative typological manner.

TYPOLOGIES

A typology is a form of categorisation of theoretical and analytical data. Qualitative social research has benefited significantly as a result of using the construction of typologies to clarify concepts. The introduction of empirical social sciences, and the concept of types and their construction have assisted in the explanation, comprehension and understanding of complex social realities (Kluge, 2000). There are different concepts of type, ranging from ideal types, empirical types, structural types and prototypes. Regardless of the typological construct, each typology is the result of a grouping process which can then be further defined as " *a combination of attributes*" (Kluge 2000). Typologies are comprised of a combination or grouping of attributes, generally supported by tables that can range in their scale of dimensions from a simple tabulated format to a complex and multilinked model, which give a visual overview of all the possible combinations and / or issues that are theoretically possible. At this stage of the development of this typology for remote sites, the concept is an empirical type, i.e. one that is grounded in observations from the real world and from literature concepts. Kluge (2000) refers to Weber (1972), Becker (1968) and Kelle (1998) who believe that there is a need for both analysis and theoretical knowledge when conducting empirical investigations (Kluge, 2000). She therefore concluded, " *It is only when empirical analyses are combined with theoretical knowledge that 'empirically grounded types' can be constructed."*Once the particular concept of type has been decided on for a particular research project, four different stages of analysis can be identified for the process of 'type construction' (Kluge 2000), these being:

Development of relevant analysing dimensions; where the type is defined as a combination of attributes (properties and dimensions), the similarities and differences are identified and then the constructed groups and types are described in further detail, i.e. identifying the research question and the theoretical knowledge, and carrying out the sampling.

Grouping the cases and analysis of empirical regularities. This involves grouping cases in terms of defined properties and their dimensions. The cases are then analysed with regard to empirical regularities, by comparing them with each other, to check for *internal homogeneity* of the constructed groups, and to ensure high external heterogeneity in terms of the variation of data and the level of the typology, i.e. comparing and contrasting the cases.

Analysis of meaningful relationships and type construction. This involves analysing the first two stages of the typology construction to establish whether there are any meaningful relationships developing between the cases, i.e. searching for contradicting / deviating cases, and considering further attributes.

Characterisation of the constructed types. This last stage involves writing detailed descriptions of the constructive types in terms of their combinations of attributes, their meaningful relationships, and finally, identifying the criteria for the characterisation of types (ideal, extreme, prototypes *et al.*).

The aim of this paper is to explore the preliminary development of a remote site typology by identifying key concepts and principles in the design management and sustainability literature, to develop attributes. The next stage involves mapping cases to further clarify the attributes. To develop the typology, the attributes are explained – to do this, we draw on the fields of design management and environmental sustainability as remote sites are often environmentally sensitive and the design process for these construction projects needs to be managed. Sustainable development, maintenance of biodiversity, and an ecological approach to design concepts are all potential attributes when constructing a typology for these sites and require further consideration of global environmental philosophies and strategies.

CHARACTERISTICS OF REMOTE SITES

Remotely located sites are most commonly thought of as those that are on an island distant from the mainland, or simply hundreds or thousands of kilometers from major urban concentrations, such as various Pacific Islands or Antarctica. These sites are typically located within environmentally sensitive regions, primarily due to the region being previously undeveloped or underdeveloped. Increasing global awareness of environmental issues and the emergent sustainability movement has focussed awareness, however, there is still very little evidence of research work conducted on remote site design management. Clearly most construction projects have a degree of remoteness and once we accept this notion we begin to view projects through the proxemics lens and explore difficulties associated with remoteness. Remoteness can be based upon a continuum related to the physical distance of participants from the site:

All project participants are initially not located adjacent to the project site, ie all design, construction and facility management actors are located in another city / urban area.

Selected groups of project participants are initially located distant from the site, for example, the design team and project / construction management teams have their offices in other countries, regions etc, but they may move to the region or have agents in the region.

The majority of project participants are located adjacent to the site and a selected few are located remote from the project site, for example, construction materials and components suppliers are required to transport their products to the site from other regions; or conceptual design teams win international design competitions and are located primarily in other countries or international clients commission new projects in various locations.

The majority of construction projects typically fall within the third category, however in this paper the first category of remoteness, which is the most extreme situation, is considered in detail. Within this type of remote site there are a range of types of projects and there are three predominant property markets including:

- Commercial projects, tourism, ecotourism
- Government / quasi government / non government organisation projects: scientific investigation, space exploration, earth evolution
- Civil infrastructure: mineral resource exploration and processing, oil/gas rigs, pipelines, dams

Remote sites can also be considered in relation to:

the distance to the site from continuously available logistical support
the difficulty of physical access to the site
the hostility of the environment in terms of climate
the extent of the availability of local /imported materials or labour resources.
the environmental sensitivity

Remote site projects offer very unique challenges to those involved in the design, construction and management process. However there may be generic characteristics and issues in common underlying the unique and different sites.

DESIGN MANAGEMENT

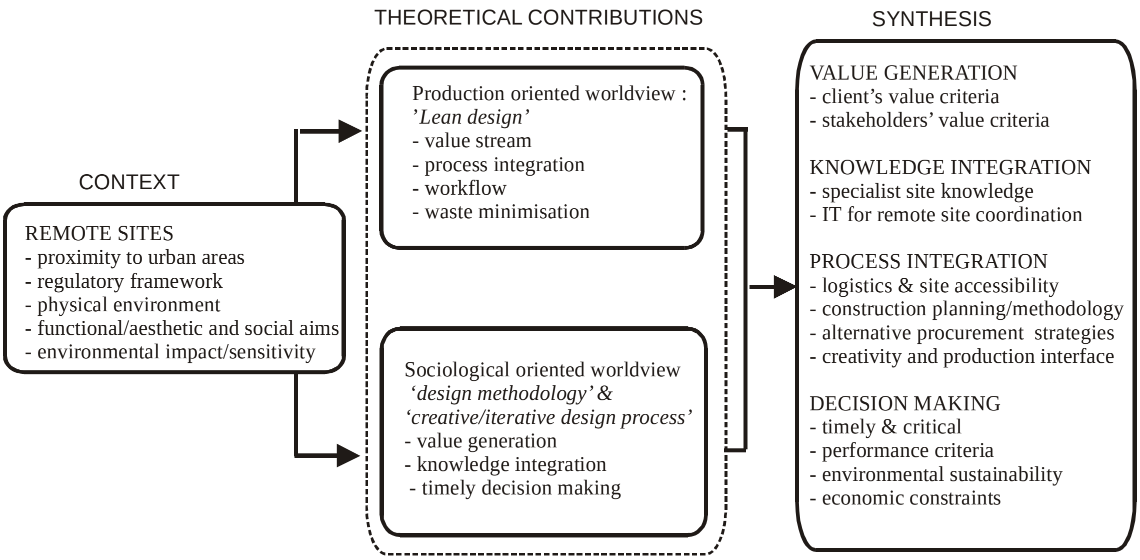
A selected review of design management and lean design management, by Kestle and London (2002), established that lean design management and design management both make important contributions to the theory of management of design. The lean design management field of research offers us such concepts as *value stream, process integration*, *workflow*, and *waste minimisation*, and is predominantly a production-oriented worldview.

Lean design management principles can be readily applied to the remote and often hostile sites in for example Antarctica, where the main priorities for the client are shelter, a strict budget and a process driven construction programme. The design management field of research offers us such concepts as *value generation*, *knowledge integration* and *timely decision making*. The design process has become increasingly complex and fragmented in recent years resulting in more actors who have design knowledge that requires integration. Within the context of remote sites an exploratory design management model was developed by Kestle and London (2002) which involved developing a model that identified the key factors of design management for remote sites by reviewing and synthesising theoretical contributions from various production and sociological approaches to design management and responding to a context of key characteristics of remote sites. The synthesis of the theoretical contributions from these production and sociologically oriented worldviews revealed four key factors including:

- value generation
- knowledge integration
- process integration
- decision making

The more holistic approach to design management as explored by a few researchers over the last few years identifies additional significant design management factors. For example, Huovila, Koskela, and Garnett, *et al.* (1998), refer to the importance of and the means to achieve sustainable development. Whilst traditional design and construction focusses on cost, performance and quality objectives, sustainable design and construction focusses on value generation, minimization of resource depletion, minimization of environmental degradation and the importance of information flow management (Kibert 1994). Minimising resource depletion and environmental degradation requires an extensive and clear understanding of the theoretical and applied research areas concerned with ‘environmental sustainability’. It is therefore important to acknowledge and describe the underlying concepts of sustainability within the context of the natural and built environment.

Figure 1 Exploratory Design Management Conceptual Model for Remote Sites



ENVIRONMENTAL SUSTAINABILITY

At the initial stages of a project, consideration of, and responses to, the environmental sensitivity of remote sites may often be paramount to the overall design development, construction or implementation stages for remote and often hostile sites. One of the underlying concepts of 'sustainability' is that our relationship with the built and natural environments is permanent and that there is an interdependent relationship between our activities and their effects on the planet. This is particularly relevant as many of the remote sites are pristine and therefore environmentally sensitive. The impacts created by any development activities, can have long-term effects on the unique ecosystems present. The United Nations defines sustainable development as " the development with which the needs of the present generation are filled without jeopardising the possibilities for future generations to fulfil their needs" (Low 2001).

In recent years governing bodies have accepted that upholding certain principles in relation to sustainable development is their responsibility. There have been varying attempts to operationalise such high ideals and philosophies worldwide. One of the most notable contributions was that made by the New Zealand government, with the introduction of the Resource Management Act (RMA)1991. It is considered notable in terms of its aims, as the concept of sustainable development was first defined and incorporated in this Act which replaced the Town and Country Planning Act 1977 and 52 statutes. When the Resource Management Act was implemented, it was the first time that environmental protection, and sustainability had become a legal requirement in any Act of Parliament internationally. The Act promotes the sustainable management of the development and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and safety, whilst - "*sustaining the potential of natural and physical resources (except minerals), to meet the needs of future generations; safeguarding the life – supporting capacity of air, water, soil and ecosystems; and avoiding, remedying, or mitigating any adverse effects of activities on the environment "(*RMA 1991). It is noted that although enshrined in policy and regulatory processes, it is also suspected that sometimes implementation can be problematic. This further supports the need for a design management model for sustainable development.

Interpretations of the intent and meaning of the RMA in terms of sustainability range across the spectrum of cultural, social, economic and developmental realities. Low (2001) - a keynote speaker at the international conference on 'Sustainability – state of the environment', contended that there were *four* issues associated with the concept of sustainability:

- avoiding / reducing wastage of resources such as gas, oil and other natural resources, but there are no objective scientific laws that tell us what are the acceptable levels of resource depletion;
- protecting the environment: preventing or reversing the process of decline and damage;
- achieving social stability: for future generations;
- establishing cultural and spiritual levels and standards (values) for future agreements

These four interpretations involve value judgements. Similarly, many articles, papers and governmental acts and policies make value judgements when referring to sustainability. "*The goals of sustainability are ecological and social, and the two issues are not separate*", (Rogers 1995). Environmental sustainability refers to biodiversity, sustainable environments, sustainable development, and ecological design.Diverse biological and natural environments have intrinsic values in terms of their visual, educational, heritage and spiritual qualities. As an example, Antarctica is frequently referred to in terms of its intrinsic value (Article 3, Antarctic Treaty 1961) and is described as a 'polar wilderness'. (Dingwall 1998).

Sustainable environments refer to the ways in which the natural and physical resources are managed to ensure that the integrity of the environment is maintained for future generations (RMA 1991). These environments are reliant on high levels of biodiversity and evidence of mature ecosystems which are rare within pristine sites. The management of these environments has largely been associated with responses to various legal instruments such as international treaties and national acts, for example the Antarctic Treaty 1961and the NZ Environmental Protection Act 1994. Associated with such legal instruments are policies and protocols that give guidance, which are sometimes legally binding or simply advisory. Consequently those that have been recognised as having attributes to be preserved for future generations have been awarded a World Heritage listing (Tongariro National Park NZ, and Fraser Island Australia. The Treaty and the associated NZ Environmental Protection Act 1994), designates Antarctica as a natural reserve devoted to peace and science. It establishes environmental principles for the conduct of all activities, subjects all activities to prior environmental assessment, gives priority to scientific research that contributes to the understanding of the global environment, and prohibits for example, mineral resource extraction, and the introduction of non indigenous animals.

Regulatory frameworks such as the Antarctic Treaty 1961, the Environmental Protocol 1991, the Resource Management Act 1991, the Nature Conservation Act 1994 and the Burra Charter ensure that any person wanting to visit, develop or alter the nature of particular remote sites adhere to strict criteria that protect the physical or heritage values of the sites for present and future generations. Once environments are established as worthy of sustainable management, then the development of these unique environments is critical.

Sustainable development has often been regarded as a discourse that disputes what sustainable development might in fact mean (Low 1999).The World Business Council on Sustainable Development effectively breaks the term into 'sustainable' meaning continued, and 'development' meaning growth, hence the market liberalists interpret this to mean growth of corporate business, and 'business as usual' almost without ecological restraint. This approach is clearly challengeable .*"Sustainable development denies the existence of global ecological limits. Sustainable development exists in a constellation with a number of other discourses: survivalism, market liberalism and green radicalism…sustainable development looks to a future beyond capitalism"*(Low 1999). For the various environmental groups, sustainable development means development that demonstrates a 'duty of care' in terms of the natural environment. Hence there is quite a marked difference in terms of the sustainable development vision between the environmental groups and the World Business Council on Sustainable Development (Low 1999).

Sustainability , as mentioned earlier in a quote by Sir Richard Rogers is both ecological and social. The ecological dimension and how it relates to design is now briefly described. Ecological design refers to a design ethic and process that has ecological responsiveness as the main focus. "*Ecological design is an anticipatory approach to design. It must be one that is critical of its influences over the earth's ecosystems and resources and one that is responsive to their inherent constraints and opportunities*" (Yeang 1995). As referred earlier in terms of design management research, a more holistic approach has been explored by a few researchers such as Huovila and Koskela (1998),and Garnett *et al.* (1998) over the last decade. They refer to the importance of and the means to achieve sustainable development. Traditional design and construction focuses on cost, performance and quality objectives, whilst sustainable design and construction focuses on value generation, minimization of resource depletion, minimization of environmental degradation and the importance of information flow management (Kibert 1994)

The selected review of design management and environmental sustainability literature has established that there are four key factors that apply specifically to remote site design management, being value integration, knowledge integration and decision making. These factors form the basis of the comparisons recorded in Table 1 and the typological descriptors, or attributes, of the three remote sites. The three sites have similar dimensions in regard to having only limited access, being pristine and environmentally sensitive, needing specialist remote site knowledge , logistical preplanning and good levels of information management.The variances in terms of attributes of the three remote sites , is in the area of value generation in particular. Therefore the case studies chosen as examples focus on the way in which value is generated for the clients and stakeholders for these very different projects on these pristine remote sites.

CASE STUDIES

The following case studies are relevant examples for the development of a typology for remote sites, because of their contrasting physical attributes and very different developmental priorities. The two sites are both in environmentally pristine regions, yet offer and generate quite different values for the particular clients. These differing generators of value are discussed in more detail in the two following case studies. The first study is of an Australian Eco tourism resort on an island off the east coast of Australia, whilst the second is the research bases built to support international scientific investigations in the Ross Sea Region of Antarctica.

1. Kingfisher Bay resort. Fraser Island (Australia)
This site was inscribed on the World Heritage list in 1992, which means that any project development has to comply with the criteria set down by UNESCO and the Australian Heritage Council (AHC). The Recreation Areas Management Act 1988 and the Australian Burra Charter are governed by the AHC, (ICOMOS 1999).

The client was the Queensland government, in particular the Department of Environment and Heritage National Parks and Wildlife Service (QNPWS). The value of the site to this particular client was realised in being able to develop this environmentally pristine site for restricted public access. QNPWS undertake the day-to-day management of this area. The following criteria were determined to ensure that this value was realised and not compromised:

- environmentally sensitive site development in terms of planting and built environment footprint;
- indigenously cultural focus in the design as a selling point to potential visitors;
- easy access for the construction processes and for the subsequent visitor population (now 300,000 per year);
- logistical support essential at construction and operational stages;
- 3- star comfort levels in terms of lifestyle, relaxation and entertainment, whilst at the same time being cognisant of the desire for environmentally sustainable principles at the design, construction and operational stages of the project;
- budget related to potential returns on investment in the project;
- customer and environs education focus.

2. Scientific Bases in the ross sea region, Antarctica
Antarctica has some 26 scientific bases and 42 countries who are consultative parties to the Antarctic Treaty. The scientific base stations and historic hut sites in the Ross Sea Region fall under the stewardship of the New Zealand Government and are managed on their behalf by Antarctica New Zealand and the Antarctic Heritage Trust respectively. Any development work has to comply with the requirements of the Antarctic Treaty 1961 and the Environmental Protection Act 1994. (Waterhouse 2001). Value in terms of these Antarctic sites lies in the pristine nature of the continent, and the fact that Antarctica acts as a global barometer in terms of climate change, and the effects of global human activities on the world’s atmosphere, oceans and ecosystems. Scientific research is the prime activity on the 26 sites in Antarctica, with limited tourist activity being very strictly controlled. The value of these sites must not compromised. In addition, the scientific activities can only be carried out during the five month window of accessibility. The following criteria form the basis of the client priorities when developing projects on these sites.

- minimal environmental impact;
- robust and reliable shelter in terms of weather protection, as conditions can be life threatening;

- logistical support essential during the construction process and intermittently at the operational stage(s);
- scale of building size and function closely related and to be kept to a minimum in terms of m2 area and budget;
- restricted window of constructability (late October to early February in any one year), hence building had to be capable of prefabrication for speedier assembly on site;
- accessibility for materials and personnel deliveries to meet the tight deadlines;
- budget related to the fiscal policies of the government of the time and to the scale and nature of the building project brief, (Kestle 1999).

The criteria are similar with respect to minimising environmental impact and access to the site for logistical support and personnel / visitors. (refer to Table 1, for a translation of the typological descriptors of the dimensions and properties (attributes) of these and other remote sites). These typological descriptors enable the categorisation of a range of remote sites and their particularities.

DISCUSSION

As a first stage of the development of a typology for remote sites, the typology analysis and discussion focussed on the development of relevant analysing dimensions; where the type is defined as a combination of attributes (properties and dimensions), the similarities and differences were then identified and then the constructed groups and types are described in further detail. Table 1 graphically identifies the attributes of the selected remote sites in terms of their properties and dimension. Issues in common between the sites are that they are each considered to be 'pristine' sites. In addition, their post development impacts have to meet strict guidelines which are closely monitored by the New Zealand and Australian governments (and their agents).

Developmental activities in terms of the Antarctic sites are conducted in terms of supporting scientific activities or providing visitor life support for the duration of their time on the continent; shelter and safety being the prime priorities alongside environmental impact minimisation. Scientific activities are restricted to six months fieldwork per year and cannot be carried out at any time in the protected areas designated as Sites of Special Scientific Interest (SSSI).

Development on sites within the Tongariro National Park (New Zealand) has to meet the strict criteria as set down in the various Acts and National Park Management Plans. Visitor numbers exceed 700,000 per annum (TNP 1996), which creates various and significant challenges in terms of needing to minimise environmental impact whilst offering an eco tourism experience. Ninety per cent of the designated sites for development have already been built on, however further development of the ski-field areas is envisaged.

Development of the Fraser Island eco tourism resort in Australia has to meet strict criteria in terms of environmental impact minimisation, and site responsive aesthetics, whilst offering visitor education on indigenous and environmental conservation. The main challenge is to manage 300,000 visitors per annum visiting this unique location, whilst endeavouring to keep the site in pristine condition.

All of the sites are remote in terms of distance from an urban area, with the Antarctic sites being completely isolated for six months of the year. However access is becoming easier due to advanced technology in terms of transportation and communications. The properties and dimensions of these remote sites are unique, a resulting in world heritage listings, and the development and implementation of an international treaty protecting the sites in Antarctica. Long term protection and monitoring of these remote sites is under threat from advancing technological systems and increasing demand for scientific investigation and eco tourism. The development of the next stages of a typology and conceptual model for remote sites becomes clearer and even more significant when reflecting on the delicate ecological balance of these environmentally sensitive remote sites.

At this early stage of developing a typology for remote sites, categorisation of specific types such as Type A, Type B, *et al.*, requires further empirical evidence to confirm and extend the various characteristics gathered to date (refer Table 1). The next stages in the development of a typology involves extending the literature review in the fields of design management and sustainable development, gathering further statistical and case study evidence, creating some meaningful relationships between the attributes, and then grouping the cases for further analysis.

The selected sites have a range of attributes that include: pristine environment; governmental monitoring; government as client; evolving and mature ecosystems; commercial value; design stakeholders; scientifically investigative activities; global impact; historical conservation; resource-rich; hostile climate; indigenous history.

The constructed types may involve a combination, or combinations, of these attributes. In addition, the constructed types may involve a combination of ‘meaningful relationships’ that exist between one or more of the attributes. These relationships may identify the interdependent characteristics of the attributes or they may describe the key similarities or points of difference of the attributes. The overriding characteristic of remoteness that occurs in varying degrees across all of these sites, means that some or all of the constructed types may need to respond in a flexible manner, to a varying range of unique remote site attributes.

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	Design Management			Environmental Sustainability
SITES	PROCESS INTEGRATION logistics, site access and construction preplanning	KNOWLEDGE INTEGRATION specialist remote site knowledge information technology for remote sites	VALUE INTEGRATION clients value criteria stakeholders value criteria	ENVIRONMENTAL IMPACT / SENSITIVITY
TONGARIRO NATIONAL PARK - NZ	Located on three volcanic mountains, two of which are still active Hostile climate, temps plus 25C to minus 10C, winds from 5 to 40 knots Limited access (4months/ year) Detailed logistical preplanning of construction phases including equipment, personnel and materials essential to meet the tight deadlines	Resource Management Act (1991), National Parks Act (1980), NZ Building Act (1991), Tongariro National Park Mgmt Plan (1996-2001) World Heritage Listing (1990,1993) Specialised design and construction technology to address extreme temperature ranges, high winds and precipitation.-	Environmental protection of site is the priority, given public accessibility Global value of the site evidenced by the World Heritage listing National Park. Primary activity is environmental and historical conservation and limited Eco tourism	Largely pristine and highly sensitive mature ecosystems Delicate ecological balance Limited number of sites for Department of Conservation ranger huts ski lodges Whakapapa and Turoa set aside as the only commercially developed areas
ANTARCTICA Ancient landmass. 2 % exposed rock. Ice sheet covers 87% of continent 11% is ice shelf. RESEARCH BASES MCMURDO DRY VALLEYS	S America:1000 km Australia: 2500 km NZ (ChCh) 3835 km Africa: 4000 km Hostile climate, very low humidity, no rain.World's lowest temp,-89.6C.Desert Limited daylight hrs for 6 months and extended daylight hrs for other 6 months. No access during winter months due to 24hr darkness, ice and high winds. Detailed logistical preplanning of construction phases including. equipment, personnel , materials to meet the minimal constructability deadlines and deliveries only by plane or ship.	Antarctica Treaty (1961): 42 nations- of which 26 are the core Protocol on Environmental Protection Madrid Protocol 1991). Detailed logistical preplanning of the construction phases including equipment , personnel and materials – Hostile climate, very low humidity, no rain.World's lowest temp,-89.6C.. Desert conditions. Specialised design and construction technology to address extreme temperature ranges, high winds and a unique marine and desert environments.	Treaty was designed for peaceful and scientific endeavours (US space program) and to protect the resources from commercial gain and to keep it a continent free from military arms. Historical Conservation – Heroic Era huts	Primarily scientific investigations Emerging Eco and Historical Tourism Aesthetics have been of secondary importance, priority given to basic human needs basis related to physical survival. Previous threat of mineral resources exploitation. Emerging regulations governing environmental sites. Pristine with a significant scientific profile -closest we get to Mars on earth Research activities limited to quantitative studies. Government concern about longterm impacts (Wharton and Doran 1999)
FRASER ISLAND, AUSTRALIA Adjacent to Australian landmass. 270km north of Brisbane	Limited access- 'Permit' access only Only accessible by boat (for example 45mins by catamaran from Hervey Bay) Detailed logistical preplanning of the construction phases including equipment , personnel and materials	**World Heritage** listed site 1992 UNESCO 1972 ICOMOS: 1999 **Australian Burra Charter –** governed by Qld and Australian Heritage Council. Subtropical, mild winters, hot and wet summers, high humidity, cyclonic zone, etc. Conditions are maritime with mean annual temperatures ranging from 14.1° C minimum to 28.8° C maximum. Rainfall is high, reaching 1,800mm on the highest dunes in the centre of Fraser Island (DASET, 1991; Sinclair and Morrison, 1990)	World Heritage listed site(1992) due to unique sand ecosystem/ dune lakes geology (world's largest sand island: complex dune systems), etc- Eco tourism Aesthetics is critical to the resort development as is the relationship between the built environment and the local human experience	World Heritage listed site due to unique sand ecosystem/ dune lakes geology (world's largest sand island: complex dune systems), etc- Pristine, evolving ecosystem and highly sensitive. Coupled with other natural and cultural significance reasons. For eg fauna (rare frogs, bats and glider species, as well as marine life) and flora ('wallum heaths' are of particular evolutionary and ecological significance, complex peat swamps), and indigenous culture. Indigenous peoples only: 1,200-2000 years ago Threat of sand mining, mineral resources exploitation and various introduced flora / fauna species Development really only limited by restrictions on new accommodation and limited restrictions on public access