CAMOGLI HOSPITAL REDEVELOPMENT:

Background Evidence on Approach to Building a new Hospital on Tristan Da Cunha

F Lange

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EVIDENCE ON DEMAND
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Report Summary

Evidence on Demand were requested by DFID to undertake a short desk study in order to prepare a technical briefing document on the approach to building a new hospital in Tristan da Cunha. Available documents were reviewed and additional information was sourced where possible.

In analysing the documents and from interaction with the stakeholders from Tristan da Cunha and DFID, a basic needs analysis was developed which led to the formulation of an initial options analysis. The independently developed accommodation schedule was compared with the previously produced preliminary space programme and the two exercises were found to be remarkably similar which indicates a certain level of consistency and confirms both calculations as reasonable.

Preliminary analysis indicates a preference for the development of a new facility on a greenfield site as well as utilising a pre-engineered, pre-fabricated modular solution for practical reasons of which quality control and speed of construction are just two. The key cost parameters, based on full life cycle costing will be construction method materials, procurement arrangements and transport costs.

The aesthetic acceptability of hi-tech solutions may be questioned as well as the environmental appropriateness of such a product. This can and should be addressed and considered on grounds such as proven positive medical outcomes and the ability to dismantle and remove at a later stage in order to reinstate the previous environmental equilibrium.

The biggest questions remain the issues related to cost, type of contract and procurement options. These are not easily resolved and would need the combined efforts of the users, funders and consultants, and could also be extended to include potential suppliers, manufacturers, contractors and even transport providers.

This report is, applicable to similar construction related projects that might be proposed for other remote locations In this regard, the outcome of this project might provide the basis for future “Evidence Based Design’ solutions as needed by other communities. Thus the root issues discussed in this document should be applicable to similar issues in other locations. The solutions may be more diverse as some conditions e.g. transport options will differ for other projects.

This document must be adjusted or updated as per agreed requirements from DFID. It must be stressed that this report is limited in scope due to time and readily available information constraints and should be considered an ‘expert opinion’. This opinion is informed by extensive previous international experience in the field of health facility planning.

BACKGROUND

Camogli Hospital was constructed in 1971 to replace the original Station Hospital which was housed in buildings constructed in 1942. The hospital was severely damaged by the 2001 hurricane which hit the island.

Photo 1 Existing Hospital (photo: unknown)

Frik Lange of Osmond Lange Architects and Planners (OL) was approached by Evidence on Demand (EOD) to prepare a desk study in order to determine the best approach to meet the community's need for a medical facility on the island. This study, in the form of a technical briefing document, will need to be agreed with the user representative body and the funding institution and should ultimately contain clear recommendations outlining an approach which should confirm the feasibility and affordability of such a project.

The study considers the three stated options of:

- A Refurbishing the current facility
- B Construction of a new facility on a green field site
- C A combination of options A and B

The difference between Options A and C comes down to the provision in Option C of high tech areas as a standalone new construction (traditional or modular). This will be on the original site and will be physically connected to the existing (refurbished) facility. Option A is pure renovations and additions and alterations – probably in a very haphazard way and not really improving on the existing problems.

Methodology

The information as provided by DFID was reviewed in order to establish the current situation on the island and to evaluate the proposed options that were tabled previously by others. Further research was conducted online utilising available information in the public domain. This included news items and articles by previous visitors and occupants including an article by Dr Gerard Bulger who previously was the local GP on the island.

In addition, two telephone conference calls with representatives from DFID and the Administrator for Tristan da Cunha, Mr Sean Burns (for the second call) were conducted.

The previous options as contained in a document titled: "Camogli Hospital Tristan da Cunha, Option 4, New Construction, Preliminary Space Programme with comments' were reviewed and considered as the main source of information in addition to other provided documents. An exercise was carried out where an independent accommodation schedule was developed in house by OL which was based on previous experience and a considerable database of historical and current projects both locally and international. This schedule is provided in Section 2 of this document. This schedule forms the basis for the calculation of the proposed building area. With the limitations in the constructions options as understood, the exercise was geared to providing the most compact solution possible whilst trying to maintain maximum usability and flexibility.

Objectives

The objectives of the report are listed below:

- Consider the approach to building a new hospital on Tristan Da Cunha
- Consider the pros and cons of the options available which include options for redevelopment of the hospital on the current hospital site.
- Prepare a technical briefing that identifies and discusses the key issues to be considered.

Planning and design assumptions

Basic assumptions were made based on international best practice and evidence based design principles. It is acknowledged that the island is unique and therefore presents unique challenges and needs, particularly in relation to transportation and logistics. The approach is thus centred around a concept of appropriateness and the following main adopted requirements:

- Adaptable care levels and family care
- Ease of maintenance and adaptability of the physical environment
- Appropriate technology

This must all add up to future-proofing the facility as much as can be achieved within the size and cost parameters proposed.

Adaptable care levels and family care

This is a necessity because of the relatively small size of the facility. The principle revolves around providing different levels of care in the same (but adaptable) environment. This assumes that a patient can be treated for different acuities in one environment. The patient can be admitted for observation, receive acute treatment and can also be cared for in a high care or critical care situation without transferring the patient to a different section or ward in the facility. Levels of care are normally driven by two factors; namely size and equipment. To accommodate the additional equipment that is normally associated with a higher level of care, the area around the patient needs to accommodate more equipment and more staff. It would not make sense to provide a dedicated high/intensive care area in this facility as the usage would be very limited.

The international trend is also to provide facilities with enough space to accommodate at least one family member with sufficient space to sleep in the same room as the patient and to assist the nursing staff with looking after the basic needs of the patient. This approach has proved very successful and has shown improved clinical outcomes for patient treated in this manner. This approach has also shown shorter recovery periods and as such shorter stay in hospital.

Ease of maintenance and adaptability of the physical environment

Maintenance costs are directly linked to the ease of access to, and quality of services and general quality of materials and finishes. The combined operational and maintenance costs of a typical health facility also outnumbers the capital costs of such a facility by a large margin. In addition, the capital cost of changes to existing facilities is a very costly exercise. All these *future* physical environment related costs can be reduced greatly by ensuring that the design and construction details take cognisance of these factors during the planning and documentation phases of a project.

Appropriate technology

Appropriate technology is vital in the unique context of such a remote island and the limitations associated with its geographic location. All material and equipment must be considered for its durability and maintenance related properties. These choices are critical when considering replacement and maintenance issues. The facility as a whole must also be able to adapt to technological advances with relative ease. The advances in health technology are one of the fastest growing sectors in the world of science and will continue to be according to predictions. The planning of space and services should reflect these trends and aim to allow for change in the most efficient manner.

Island Logistics

OLA have engaged in high level discussions with WSP South Africa regarding transport logistics with specific reference to infrastructure projects. It is clear that this will be a crucial ingredient of any feasibility and costing exercise. Tristan da Cunha is recognised as one of the most unique locations in the world and it is difficult to find a ‘comparable’ example of a similar facility. The Falklands has a population of nearly ten times that of Tristan da Cunha, is not as remote and has a much bigger infrastructure and therefore much better existing logistical capacity.

Transport logistics for Tristan Da Cunha are manageable and there are numerous logistical solutions which may vary from using scheduled transport opportunities (currently 3 vessels are scheduled to make 9 return trips a year, for further details see: http://www.tristandc.com/ships.php) to the real option of chartering a dedicated vessel for this specific project. Access problems include crane capacities, a harbour often not accessible in bad weather, particularly during the winter, and the movement of heavy items on island. These possibilities can only be investigated in more detail, later in the project, with more specific information. Transport and handling costs are considered further below in the section below on costs.

M/V Baltic Trader
Abt. 1850 DWTCC

Panamanian Flag IMO Nr: 7396472 Call Sign 3EJC2

585 sq.m - abt. 2,15 m heigh
380 sq.m. - abt. 2,35 m height
250 sq.m. - abt. 4,15 m height (in hatches)
Palletcarrier - 6,2 m wide sidedoor
2 x 4,5 mt palletlifts
3 forklifts 2,0/2,5 & 3,0 mt lifting capacity
2 HA/ 11,4 x 9,7 m and 14,7 x 9,7 m
1 x 30 mt crane

1 x 5 mt derrick covering hatch 1
57 TEU, of which 25 TEU's on deck.

Type: MPP General Cargo/Pallet carrier (with side door)
Built: 1975 in Norway - 1987 Norway
Rebuilt: 1987 lengthened in Norway
Class: I.N.S.B , +1A1, Ice C, E0
Dim. 82,47 x 12,70 m

Main Engine: Carterpillar, 8RVB, 3006, (1641 KW), 2,232 Bhp
The main engine is NEW - totally ovehaoul 2002.

Service speed: around 10,5 knots on abt. 6,25 tons Gas Oil
Bow propeller : 250 hp side propellar forward

Cargo hold: Grain: 146.727 cubic feet (ca. 4.146 m3)
Bale 133.126 cubic feet (ca. 3.770 m3)
Container: 57 TEU (32 TEU + 25 on deck)

Cranes: 10 tonns derrick forward serving hatch: 11,40 x 9, 70 mtr
25 tonns crane midship serving hatch: 14,28 x 9,70 mtr
Pallet lifts: 2 x 3.5 mt hydr. cargo eleators on starboard side
Slide door: 1 side door 6,3 m wide x 5.0 m high on starboard side

Electronics: Fully equipped with modern electronics on the bridge

Varoius: Vessel trading in South Atlantic Waters, Cape Town-Tristan de Cunha- Brazil.

NEEDS ANALYSIS

Accommodation Schedule

The accommodation schedule represents the calculated need of the facility taking all known factors into consideration. Due to the perceived problems with any type of construction on the island due to the logistical factors related to accessibility and available workforce and skills, a concerted effort was made to keep the facility as compact as possible without sacrificing the operational functioning. In keeping with this approach, a number of areas were planned to be shared by inpatients and outpatients. This will necessitate good planning with an emphasis of placing shared facilities in a shared core with easy access from all related sections/departments of the facility. The size of the facility will benefit from this arrangement as well as enable this approach. Where possible, areas were also planned to be multi-functional and adaptable.

OPD	No.	Area / Unit	Area	Notes
Waiting/Reception	1	16	16	Shared
Consulting Room	2	12	24	1 GP + 1 Dentist
Dental Workshop	1	9	9	
Procedure Room	1	12	12	Includes POP room
Specimen / Lab	1	9	9	Shared
Sluice Room	1	8	8	Shared
Store Room	1	9	9	
Patient / Visitor Ablutions	1	4	4	
Staff Ablutions	1	4	4	
Staff Rest / Change	1	12	12	
Meeting / Education Room	1	12	12	Also Library
Kitchen	1	9	9	Shared
Admin Office	1	9	9	
Doctor Office	1	9	9	
			146	

INPATIENT WARDS	No.		Area	Notes
Waiting/Reception	0	16	0	Shared
Single Bed Ward	4	18	72	With en-suite
Sluice Room	0	8	0	Shared
Store Room	3	9	27	Linen, Consumables, Eq
Patient / Visitor Ablutions	0	4	0	Shared
Staff Ablutions	0	4	0	Shared
Staff Rest / Change	0	12	0	Shared
Kitchen	0	9	0	Shared
Day Ward / Observation	1	11	11	2 beds ?
			110	

PROCEDURE CORE	No.	Area / Unit	Area	Notes
Waiting/Reception	0	16	0	Shared
Procedure Room	0	12	0	Includes POP room
Specimen / Lab	0	9	0	Shared
Sluice Room	0	8	0	Shared
Store Room	1	9	9	Emergency equipment
Store Room	1	9	9	Theatre equipment
Staff Ablutions	1	4	4	Behind red line
Staff Rest / Change	0	12	0	Shared
Operating Theatre	1	42	42	
Holding / Recovery	1	28	28	Emergency/Resuscitation
CSSD/TSSU (Sterilising)	1	12	12	Includes autoclave
Scrub area	1	4	4	Shared
Mortuary	1	8	8	Room or Fridge ?
X-Ray Storage bay/Room	1	5	5	
Ultrasound Room	1	8	8	
			129	

GENERAL	No.	Area / Unit	Area	Notes
HVAC Plant	1	9	9	Shared
Gas Store	1	9	9	Shared
Outside Store (Bulk)	1	18	18	/ Major disaster store
Ambulance Garage	1	24	24	
Computer / Server Room	1	6	6	
Workshop	1	9	9	Basic with workspace
			75	

Total Net area from Accommodation Schedule			589
Circulation	25%	147.25	
Structure	8%	47.12	
Fit factor	2%	11.78	
Contingency	3%	17.67	
Sub Total		223.82	223.82
Total Gross area			**812.82**

The estimated total gross need is calculated as a construction area of 813m^2. This figure is used for all calculations in this desk study.

The existing facility has a gross area of 357m^2 and an applied fit factor of 15% would calculate to a usable area of 310m^2 which would leave a new build gap of 503 m^2.

Refurbishing Option: 'Fit Factor' is quite high (if 14m^2 is required for a specific function or a room and the existing room used to accommodate this requirement has an area of 17m^2, then there is a waste factor (fit factor) of approximately 18%).

A fit factor of 15% was assumed for this study.

The area calculations are solely based on the minimum need for the community and cannot be based on rules of thumb or need norms as there are no norms in existence for such small communities. As such a minimum list of rooms has been drawn up and to that list appropriate areas have been allocated which resulted in a m^2 need calculation. This can however be adjusted up or down with further cooperation of the island's management. The areas allocated are within worldwide accepted norms and are not extravagant.

The size of the proposed facility as per the accommodation schedule has been calculated to 813 m2. This size can be compared to a successful small facility in Zimbabwe of about 1,400 m2 which has 14 beds. There are not many facilities smaller than that because of economy of scale – the cost per bed increases or decreases proportionally as the number of beds change due to the shared facilities common to hospitals or clinics. A two bed facility and a twenty bed facility would require approximately the same size Operating Theatre facilities for instance.

In comparison the planned facility for Tristan da Cunha at 813 m^2 represents very good space planning and does not represent excessive space allowances. The 5% contingency can be omitted and another 5 – 10 % space can probably be saved during a detailed planning and design phase, but at this stage it is recommended that a minimum area of 750 m^2 be used for any feasibility studies. It is however a strong recommendation to work with the 813m^2 which was independently calculated based on OLA's experience.

Approach

Tristan da Cunha has requested DFID to support the building of a new purpose built small hospital. The current hospital is not fit for purpose and will not be able to fulfill future demands by the islanders.

The approach to providing appropriate medical services on the island should be based on the best clinical outcomes for the people of the island and weighed against other factors including affordability (capital, operation and maintenance). This outcomes based approach would rely heavily on the availability of four main components:

- Clinical services by qualified medical practitioners
- Physical facilities (buildings) in which to provide clinical services
- Equipment that can facilitate the provision of clinical services
- Medicine that can be used in the treatment of disease and illnesses

The study considers the three stated options of:

A Refurbishing the current facility
B Construction of a new facility on a green field site
C A combination of options A and B

In addition, the services need to be supplied in a sustainable manner which will rely on the physical environment and also the affordability component as a whole. It would be normal to consider whole life costs as a means of balancing capital and operation and maintenance requirements. Capital, maintenance and operation can be regarded as three separate issues. Capital is self-explanatory. Operation costs need to include the costs of services like water, electricity etc., and the cost of staffing the hospital to an acceptable level. Both could vary with the design of the facility. Maintenance costs refer to both the equipment and the structure of the building. The approach adopted here is that the operational cost, being a direct derivative of the quality and appropriateness of the physical facility, necessitates the investment of the right capital amount to ensure sustainability.

OPTION A: REFURBISHMENT - BROWNFIELD

PROS	CONS
Should theoretically be the cheapest solution when only considering capital expenditure	When considering life cycle costing, the situation changes to be ultimately much costlier than the replacement with new options
	Would necessitate a phased approach which usually extends the construction period significantly
	Does not normally resolve all existing problem issues
	Does not necessarily improve ease of maintenance as substantial portions of the original facility cannot be upgraded due to cost,

PROS	CONS
	time and accessibility constraints
	Hidden costs due to unknown issues usually only discovered during construction increases capital costs and causes budget overruns.
	Less than ideal space standards

OPTION B: NEW CONSTRUCTION – GREENFIELD

PROS	CONS
No need to decant existing facility	Higher capital cost
Once vacated, original building can be refurbished (not high tech) and used for alternative needs	
Low fit factor because of 'for purpose' design process	
Lower maintenance factor through innovation and choice of materials and quality control	
Modern solution and can be more adaptable for future proofing	
Better sustainable solution	
Potential for better acceptance by users, better medical outcomes linked to improved confidence and satisfaction	
New buildings can be designed and constructed to specific requirements e.g. to be hurricane 'proof' which would make it the disaster management hub of the island	
Most likely to have the shortest total construction period	
Ideal space standards	

OPTION C: COMBINATION OF OPTIONS A & B – BROWNFIELD

PROS	CONS
Should theoretically be the 2nd cheapest solution when only considering capital expenditure	When considering life cycle costing, the situation changes to be ultimately much costlier than the replacement with new options
The new build portions of the project will have the same advantages as for Option B	Would necessitate a phased approach as for Option B which usually extends the construction period significantly
	Does not normally resolve all existing problem issues
	Does not improve ease of maintenance for the old part of the development

Acknowledgement should be given to the basic rule of thumb principle that states that when the refurbishment capital costs exceeds 60% of the replacement capital costs, the replacement option becomes more viable and this viability increases as the percentage increases. This is based on evidence from actual medical facility projects where both new and refurbishment projects of comparable size and specifications were evaluated post construction and occupancy. It was found that maintenance of the new build projects were significantly lower than refurbished projects which ultimately make the new build option more sustainable and better value for money.

CONSTRUCTION OPTIONS

Pros and Cons of possible construction options

Construction options are compared in terms of what is considered to be the most obvious pros and cons for each option. These options are however uniquely different when considered with the demographic problems associated with Tristan da Cunha.

Pre-manufactured, Modular, Alternative Construction

PROS	CONS
Savings in weight	Not easily altered / changed by users
Less waste	Possible higher cost
Better quality control	Skilled / specialist labour may be required
Faster construction	Special consideration to transport options. And the level of skills available on island.
Not relying on Island labour	
Could afford training opportunities & skills transfer	
Solutions can be applied to similar projects on other remote locations for example the Falklands Islands	

Conventional Construction

PROS	CONS
Semi- skilled labour for majority of work	Longer construction period
Potentially cheaper	Labour intensive
Better aesthetic integration	Difficult to maintain quality
	Handling of large quantities of materials and the need for large amount of local labour need to be considered.

Pre-manufactured & Conventional Combination

PROS	CONS
Semi- skilled labour for majority of work	Longer construction period
Potentially cheaper	Labour intensive
Better aesthetic integration	Difficult to maintain quality
High technology portions of project conform to same 'Pros' as for the Pre-manufactured option	High accumulative weight of building – transported portion could be a major issue
Conventional portions conform to the same 'Pros' as for the Conventional construction option	

Further investigations concerning the options above need to be carried out. These would consider the availability of proprietary construction systems or methods and the possibility of using those systems for construction on Tristan da Cunha. The investigations should weigh the possibilities of using any systems or methods against the constraints of size, bulk, weight etc. linked to the transportation options available (further details are provided in the section below on transport costs).

Modular Construction

Mr Sean Burns, Administrator for the island concludes in a letter dated 22 March 2012 that “It is unfortunate that Tristan does not currently have the financial or human resources to carry out anything more than basic repairs and if we are to improve the facility, external assistance (financial and technical) will be required.”

This in essence is the biggest and defining challenge for this project. It indirectly confirms that any conventional building method will be carry huge risks with regards to time and quality in the first instance and as a result also financial and operational risks. Fit for purpose and appropriate technology should be cornerstone concepts for this project.

The big advantages of modular construction are quality control and material management. In addition, speed of erection can also be of great advantage, especially with reference to the remote location of this project.

The following graphic illustrates the basic differences in the construction schedule of modular and conventional building projects.

Although this is simplified and generic, it is very applicable to this project. The most important issues relevant to this project would be the size, weight and cost of the modules.

Taking into account the remote location and other logistic issues, it is clear that whichever building process eventually becomes the preferred option, almost all material whether in raw form or pre-manufactured, will have to be transported to the island. Conventional raw material like cement and steel reinforcing etc. may prove to be much more bulky and heavier than pre-constructed elements.

This modular approach will have to be addressed in far greater detail in the proposed feasibility document.

COSTING

Estimates

Any costing exercise at this stage is very high level and must only be considered as initial assumptions to facilitate early macro planning exercises and for discussion purposes only.

In a document named "*Refurbishment and expansion of Camogli Hospital*" dated 04.03.2011, new estimated construction costs of £1,250/m^2 were provided. These costs were based on the reported construction costs of the Post Office and Tourist Office which had been constructed by a South African company. In a subsequent document titled "Camogli Hospital Tristan da Cunha, Option 4, New Construction, Preliminary Space Programme *with comments*" dated December 2012, provided by DFID, the rate was escalated to £1,375/m^2. This document also referenced an estimated minimum rate of £2,000/m^2 as an indication of possible pre-manufactured costs to include shipping costs from UK. These rates need to be tested in the proposed business case, but are accepted as basis for the desk study. For now it is also assumed that these rates apply to all options originating from either the UK or South Africa.

Applying the £1,375/m^2 rate to the 813m^2 of the accommodation schedule exercise, the projected cost estimate for a new facility utilising conventional building methods would be estimated to be approximately £1,117,600. In the event of pursuing the pre-manufactured or modular construction option the estimate can be adjusted to approximately £1,600,000.

357m^2 and an applied fit factor of 15% would calculate to a usable area of 310m^2 which would leave a new build gap of 502m^2. If the refurbishment costs are calculated at 30% of the new build costs, then Option C can be estimated to cost approximately £818,125 (73% of complete new build).

357m^2 at £412/m^2 = £147,000 which can be seen as the minimum spend to refurbish the existing hospital only – this would not address the inadequacies of the existing facilities in terms of under-provision of area and lack of adjacencies. This would not be a recommendation at this stage.

These very basic estimates exclude any bulk earthworks (up to 10%), contingencies (10%) and professional fees (up to 15%) as well as possible extra over insurance and other preliminary costs. These additional costs could be anywhere from 15% to 30%

The size, as discussed above, is realistic based on other small facilities. OLA have compared facilities in places like Zimbabwe, Sudan, Eritrea and Ethiopia which are similar in size. None of these countries are subjected to the same kind of logistical problems as Tristan, however. Tristan da Cunha is recognised as one of the most unique locations in the world and it is difficult to find a 'comparable' example of a similar facility.
With a full feasibility study, more time can be spent on the two main issues that will determine the final decisions regarding the implementation of this project. They are Construction Method and Construction Cost. These need to be addressed in much more detail than what was allowed for in this Helpdesk study.

Construction Method

Modular construction would at this stage seem to be the preferred option. The specific type is the next question and needs detailed option consideration. Choices include container sized prefabricated boxes which takes up a lot of volume as you have to transport the 'space' between walls, floors and ceilings. The other options include knock down panels which has to be erected or assembled after transportation. This option uses much less volume or bulk but needs more labour.

Transport Cost:

Construction cost is the result of the method and the transport and labour cost permutations. These are numerous and are based on bulk and weight. If a ship has to chartered, costs could be in the region of $14,000 a day and the return trip duration for loading transport and off-loading could be between 30 and 40 days ($490,000 for 35 days). Very high level calculations have estimated the construction weight of the project to be between about 300 and 900 metric tons. The cost mentioned here is for a vessel with a 2,000 ton capacity which means that it is too big and therefore one would have to sell additional space etc. One could expect to probably pay less than half of that (estimated and to be confirmed) if the transport takes place on a regular scheduled trip by for instance the Baltic Trader.

If, for example, the modular construction involved knock down panels, and the weight was estimated at 300 ton, transport would cost about $190 / ton (or m^3 whichever is the greater) which would calculate to $57,000. On top of this harbour and stevedore costs could be about 15% of $57,000 which calculates to $8,550 which works out to approximately $65,550 for transport costs alone.

If we work on the assumptions above then cost for transport would calculate to about $39,000 for modular pre-fabricated (light weight) panels. Normal building material must also be transported to the island and if a normal construction method is preferred, the transport costs (because of weight) could be up to 3 times more which would calculate to an extra $78,000.

All the above is based on transport from Cape Town, South Africa.

CONTRACTS AND PROCUREMENT

Contract and procurement options

It is extremely difficult at this stage to recommend any specific contract but it would be prudent to use an internationally accepted standard contract document as a basis for this project. This could be dependent on the eventual option that is adopted and could be UK or South Africa specific. In the event of a pre-manufacturing option, a non-standard contract specific to a proprietary manufacturer may become the preferred option.

There are two basic options available for the procurement of the building project. These are a "Design & Build" (Turnkey) or a "Design & Tender" (Traditional) option, with some possible derivative versions of both. Both of these options can be tied to the concept of a reference design. The first option of Design and Build is the best option if innovation is required but could be difficult to evaluate and is normally also more difficult to administer when it comes to quality assurance. The traditional option is normally easier to evaluate as tenders are based on the same documentation but innovation is normally limited. A procurement approach can, in the author's opinion, only be decided on after the completion of the business case and after the completion of further investigation into alternative materials and methods as mentioned in Section 4. There is a strong probability that the best option could be to provide a reference design which would control the sizes and adjacencies of the facility which could then be used to obtain a Design & Build tender which would provide the construction solution in terms of materials and methods.

It would be prudent to point out from the beginning that the whole tender procedure might be challenging as the logistics of construction and even the tendering process may discourage potential contractors from tendering. This could potentially delay the project.

Issues such as pre-qualification of tenderers is a strong possibility and could be linked to an expression of interest exercise, but this can only be decided once there is more clarity as to the preferred option of the users and the client.

INFORMATION GAPS AND GENERAL NOTES

General notes and questions

Survey Information

At present the survey information has only been briefly reviewed. The surveyed area scales to approximately 50 x 70 m = 3,500m^2; this is more than adequate if a new build project will be about 813m^2.

There is about 4 – 5 m drop in height over approximately 50m in a South North direction (1:10). This is a gentle slope although 1:12 is the acceptable standard for wheel chairs. This should not create major problems but a geo-tech investigation is recommended.
A new Doctors residence mentioned in the documentation supplied has not been addressed in this report

Possible restrictions on Options

Possible restrictions on options include:

- Maximum transport dimensions
- Maximum transport weight
- Maximum transport bulk
- Container delivery options
- Transport opportunities, frequency
- Available raw material
- Available workforce
- Available skills
- Maximum dimensions and weight that can be handled without mechanical assistance
- Temporary provision of mechanical equipment or permanent procurement of a super multi-functional 'MANITOU' (which could change the options quite drastically).

Logistical Details

If the size and weight of material to be transported becomes a logistical problem, what are the chances of a chartered or dedicated ship that can transport all necessary material in one shipment?

Information from *How much does your building weigh? — R. Buckminster Fuller* recommends:

Potential weight of raw material and / or pre-fabricated modular elements can have a big impact on both the feasibility and the affordability of the project. Some information gathered indicates that a timber frame construction building to US standards can be estimated to weigh about 60 psf (pounds / square foot) of floor area. This converts to 28kg/0.093m^2 which equates to 300kg/m^2 (excluding foundations).

Unconfirmed information indicates that a typical brick building weighs about 900kg/m^2. This would mean that the new facility could weigh in at:

800m^2 x 300 kg = 240,000 kg for a timber frame or similar lightweight construction

800m^2 x 900 kg = 720,000 kg for a traditional brick or block construction

Depending on the material that needs to be shipped to the island, this would be an indication of the logistical problems that may potentially arise with regards to transport which are more likely to relate to unloading and handling on the island than cost or capacity of the ship.

Construction methods

Construction methods that should be considered include:

1. Steel frame construction
2. Timber frame construction
3. Masonry construction

4. Adapted in situ concrete construction (successfully used in Comoros Islands using volcanic rock as aggregate. An outer cavity wall construction using local materials could be a possibility.
5. Tilt-up construction (GRC) using molds etc.
6. Flat pack or panelized modular options

Building minimum requirements

Minimum requirements should include adherence to:

- Fire regulations
- Acoustic performance of material
- Corrosion issues with material
- X-ray – radiation control & safety (UK)
- Standby power (UPS)
- Weather proofing (worst case scenario – Hurricane proof)

CONCLUSIONS

Recommendations

The primary recommendation is that an urgent, in principle, agreement be reached in which the Island authorities and the funding organisation make a final choice as to the preferred option for refurbishing, or replacing, the current facility. This would enable the team to proceed in a more focused manner concentrating on one replacement option only. This option can then be considered for the further issues of construction method and procurement method analysis which would ultimately culminate in one preferred option solution which can be put to market.

This report further recommends that “OPTION B: NEW CONSTRUCTION – GREENFIELD” be adopted as the preferred option. This option will probably be the most expensive capital cost option, but it is also likely to be the most affordable option in terms of life cycle costing. In addition, if linked to a pre-manufactured construction option, it will also most likely provide for the quickest construction period and the least disruption to the continued provision of health services on the island.

This report was intended as a prerequisite for the development of an official Business Case for the provision of health services on the island and it is therefore recommended that such a business case be procured as soon as possible and that it considers the procurement of Option B as a first priority. Only in the event of this business case proving total unaffordability of the preferred option, should Options A and C be reconsidered with Option C then being the preferred option of the two.

A full study of available transport capacities should be conducted (e.g. material, size, weight, quantity etc.) to make details available to interested tenderers and which can also be used to evaluate the possibilities for each possible option under consideration.

A full material study is also required of possible available island raw materials and its application possibilities (stone, sand water, etc.) including any necessary treatment processes to ensure and improve the usability of such resources.

In order to be able to compare any proposed solutions in a rational manner, it is proposed that a Reference Design be prepared which will then form the basis of all solicited proposals. This Reference Design must also be adopted and signed off by the user representatives and the funding body. Such a design will be indicative and set boundaries within which any tenderers can maneuver without stunting the possibility of optional innovations or alternative solutions. The detail of such a design must be to minimum standards to ensure clear adjacencies, size and circulation of users and positioning and distribution of services.

The reference design must be supported by a design brief with outcome specifications and clear clinical flow diagrams – this must be developed in conjunction with the users.

The design can be used by a consultant quantity surveyor to prepare an elemental cost estimate for some of the possible solutions.

It is also an option that the design be used at an early stage to go to market for expressions of interest by the private sector.

Alternatively, the Reference Design can be used to go out on official tender for provision of documentation and construction services. This will probably take the form of 'design and supply' tenders which would use the reference design as a basis to solicit innovative construction options.

A third option (not recommended) would be to put out a tender for a straight forward design and supply tender or Request For Proposals based on a briefing document with output specifications. This could be difficult to evaluate, however.