14. Concluding Remarks

14.1 Objectives and Achievements of the Study

The contract for "*the Consulting Services for the Feasibility Study on Infrastructure Development for the Lamu-Southern Sudan-Ethiopia Transport Corridor and the Master Plan for the Proposed Lamu Port at Manda Bay & Detailed Design for the First Three Berths & Associated Infrastructure*" was signed on 13 May 2010 between the MOT in the government of Kenya and JPC in consortium with BAC/GKA JV Company.

The Services consist of two major activities, i. e. (1) FS for *the* LAPSSET Transport Corridor Project and (2) MP and DD study for the new Lamu Port Project, including preparation of tender documents. This Project is defined as one of the flagship projects in the government long-term policy programme "Kenya Vision 2030." Because of importance and urgency of the Project, the study period of the Services is limited to nine months in total for the FS for LAPSSET, including six months for MP and DD for the new Lamu Port.

As of late October, 2010, the following study outputs have been obtained:

14.1.1 LAPSSET Corridor FS Study

1) Alternative **corridor routes** have been discussed by means of:
   a. Route analyses based on the available geographical maps with scales of 1/50,000 and 1/100,000,
   b. Site surveys on the route conditions by means of aerial observations and land observation from vehicles on site, and
   c. Network analyses of the six major alternative routes.

Then, the route connecting the following nodes was selected to be the routes of aero-photo mapping survey on 12th July, 2010:

(Sudan Route: 1,720km)

Lamu – Garissa - Madou Gashi- **Isiolo** – Kisima - Ngi Nyang – **Lokoni** – Lokichar – Lodwar – Lokichokio - **Nakodok**.

(Ethiopia Route: 470km)

Isiolo – Samburu - **Marsabit** – **Moyale**

2) **Aero-photo mapping survey** by airplanes has been on stand-by because of unfavorable weather conditions and is already delayed for more than two months. The survey at Lamu and Garissa areas is finished, and

3) Preliminary **schematical design** on the selected routes of Railway, Highway, and Pipeline have been made based on available geographical information and technical standards.

4) Study Team dispatched **a mission to the Southern Sudan and the Ethiopian governments** in early July to collect information and data on their policies related to the development of the LAPSSET Transport Corridor. **A second mission was sent to Ethiopia** in the middle of October to collect additional data. Both governments expressed optimism for early implementation of the Project, including construction of new Lamu Port.

5) Preliminary **demand forecast** of freight and passenger has been prepared at the two stages of 2020 and 2030 based on the information and data collected above for planning of Lamu port and corridor facilities. It is estimated that the total cargo throughput at Lamu port amounts to 13.5 million tons in 2020 and 23.9 million tons in 2030 which is larger than that of present Mombasa Port.

6) The LAPSSET Corridor is planned to have a total width of 200m at **standard sections** where the width or Right of Way (ROW) is shared by Highway, Railway and Pipeline of 100m, 70m and 30m wide each, respectively.

7) Based on the demand forecast and temporary route setting, the **railway construction plan** with the **standard gauge** formulated for the Lamu Section, i.e. Lamu-Garissa-Isiolo, the Southern Sudan Section, i.e. Isiolo-Nginyang-Nakodok., and the Ethiopia Section, i.e. Isiolo-Moyale. The modal share of railway in 2030 is expected to be 57.5% at Lamu Section, 96.1% at Southern Sudan Section and 93.2% at Ethiopia Section.

8) It is estimated that number of freight trains on the busiest Lamu Section will reach 78 trains per day in 2030. Thus, it is planned that, until the target year of 2030, the railway keeps **the single track line**. Furthermore, in view of long distance and high construction cost for electricity supply (Cost of KShs 80 billion for about 1,800km long power transmission line) the railway shall be operated by the **diesel driven system** to minimize the capital and maintenance costs. The railway line crosses many rivers and needs many **bridges**, most of which has a length of less than 150m. At the section between Isiolo and Nginyang, it is estimated that five **tunnels** of 5 km long each will become necessary to abide by the maximum gradient of 1.5% to pass the Rift Valley part.

   The railway development plan between Isiolo and Nairobi through the eastern skirts of Mt.Kenya is under discussion as an additional necessary link of the Corridor.

   Construction of LAPSSET Railway Network is expected to take three years and will complete by the end of 2015, subject to all necessary arrangements will be satisfactory made.

9) Construction plan of LAPSSET Corridor **Highway** is being discussed. The highway routes are planned to pass mostly through the same routes as those of railway on plain areas. The routes basically follow the existing roads except the Lamu-Garissa section and a **missing link** between Isiolo and Nginyang. Initially the highway is to be constructed as two-lane road with a standard width of 11m (= 2 x carriage way 3.5m + 2 x shoulders 2.0m).

   In consideration of sections between Isiolo-Moyale and Isiolo-Nairobi are under construction by *the African Development Bank* and *the World Bank*, the remaining length is about 900km for the LAPSSET Corridor Project.

   Construction will take three years by separating the total length into four segments which are to be constructed simultaneously.

10) **Oil Pipeline** is planned parallel to the highway routes, i.e. crude oil pipeline from Southern Sudan to Lamu via Isiolo with a capacity of 500,000 barrel per day. Another pipeline, which is for refined oil, is planned from Lamu to Moyale through Isiolo.

11) Scoping of **environmental issues** are now under discussion for environmental considerations related to LAPSSET Corridor Project

14.1.2 Lamu Port DD Study

1) The **major principles of Lamu Port development** are set out as follows:

   a. Establish the new gateway port for the LAPSSET Transport Corridor,

   b. Target at 2030 as defined in “Kenya Vision 2030”, considering very long-term development (Beyond 2030 Stage) of the port and the hinterland city, by means of development of transportation, industrialization, tourism, and others,

   c. Secure efficient ship and cargo operations at *the Port Area* and safe ship operations in the harbour within *the Port Limit*,

   d. Confine development areas for the port on the west coast in Manda Bay by zoning port,

industrial, tourism, urban, residential areas and environmentally important areas for the Cultural and Historical Heritage, natural environmental resources including mangrove forests, sea turtle nesting beaches, etc.,

e. Preserve the current local transport networks including channels for small Dhows and speed boats, and

f. Others..

2) Site surveys on maritime natural conditions have been carried out on site, i.e. **hydraulic, bathymetric and geophysical surveys**, which were completed at the beginning of August. There are important facts revealed through these surveys such as channel profile and seabed materials (course sand at outer channels, coral rock at Manda Pass and middle-size sand in Manda Bay), water depth of the port area, sub-bottom materials (mostly sand) and soil layer composition (bearing stratum of hard weathered coral rock), and other facts. The bearing stratum is shown by contoured map, which revealed very complicated layer profile.

Another kind of survey is **geotechnical survey** to identify underground soil conditions through 28 borings in the sea and 9 borings on land, in total 37 boreholes. It has also provided important technical information that the foundation of the port area is very strong, consisting of sand on the surface and weathered coral rock beneath it, which can bear loads on the surface of the port.

The above surveys were delayed for about one month due to unusual unfavorable weather conditions on site and delay of coordination arrangement with the Navy Base, which affected the schedule of the subsequent study and design works.

3) **The Long-term Development Plan** of new Lamu Port in terms of port facility arrangement is formulated based on the above preliminary cargo forecast, meteorological and oceanographic analyses, and results of hearings from the local government as well as other related organizations. The location of the new Lamu Commercial Port is selected at the western coast of Manda Bay.

4) **Channel and basin plan** is prepared with depths of 18.0m at Main Channel, 13.0m at Sub-channel, 17.5m at Manda Pass, and 17.5m at the basin of Bulk Berth, 16.0m at Container Berth, and 12.0m at General Cargo Berths.

5) Alignment planning and preliminary design of **the first three berths** have been made at *the Island of Shaka la paye* to the south of the Navy Base in Manda Bay, i.e. one 100,000 DWT Bulk Berth, one 100,000 DWT Container Berth and one 30,000 DWT General Cargo Berth. The general cargo berth should be convertible to a container berth in the next stage, or it had better be designed as a multi-purpose berth for the time being.

6) Planning of **the associated infrastructure** with the port facilities are also proposed, including electricity supply, water supply, communication systems and security measures. The proposal includes, for short-term plan, introduction of electric generators at the port, water pipeline construction from a water supply company, construction of a fiber optic cable network and IMO-ISPS security facilities.

7) Necessary **cargo handling equipment** is discussed and designed. Minimum required equipment is proposed to be procured by the PMB and be leased out to terminal operators, including, for container berth, two Over-Post–Panamax Container Cranes (SSG), four Transfer Cranes (RTG), and other small forklifts; and for general cargo berth, one mobile crane.

8) Considerations on **institutional and financial arrangements** for implementation of the Lamu Port Project are proposed taking account of the most suitable institution as the Port Management Body (PMB) for the completely new port, port management systems, and financial systems such as PPP and public subsidiary. In this context, KPA's involvement is considered indispensable with appropriate legal and financial arrangements. The **Port Area** and **Port Limit** are proposed, the latter is to be defined based on the present KPA Act.

9) **Construction Method and Schedule** for the first three berths are discussed and proposed, in which a basic concept is introduced that the General Cargo Berth is expected to be first operational as soon as possible, i.e. by the end of 2012 as far as possible. This berth will play a vital role of the nucleus of the port to bring in construction materials for construction of new Lamu Port and the LAPSSET Corridor. The face-line and yard area are finally decided based on discussions on the balance of dredging and reclamation volumes, which is about 11 million cubic meters.

10) Environmental baseline study has been carried out to prepare **the EIA Report** which is to be submitted to NEMA.

14.1.3 Planning of Other Corridor Components

1) Candidate locations for **Airport** development are discussed at Lamu, Isiolo and Lokichokio. After comparison of three alternative locations in Lamu, i.e. Bargoni, Mkunumbi and Wifu, Mkunumbi at the suburbs of the planned new Lamu City area is selected as the best new Lamu International Airport site with the main runway measuring 2,500m. This evaluation is made based on i) Accessibility, ii) Adequacy in land area for airport development, iii) Development cost implication, iv) Harmonization with the present and future land use of surrounding areas, and v) Environmental considerations.

   At Isiolo, the present airstrip, which has not been operational, is considered to be suitable as the domestic airport to be used when number of passengers will increase. When the number will further increase and larger airplanes will be introduced, a new airport could be planned at the north of Isiolo city.

   At Lokichokio the existing airstrip is selected to be used with necessary rehabilitation works. Their airport development layouts are proposed.

2) Concept and locations of development of **Resort Cities** are discussed at Lamu, Isiolo and Lake Turkana areas. At Lamu, one core site has been proposed and linked to five satellite sites in relation to maritime leisure activities. In Isiolo, three areas are identified to be the candidates of resorts, i.e. Quarantine Area, Kipsing Gap and Archers' Post. Candidate sites for Turkana Resort City are Loiyangalani, Kalokol, and Lokichokio. Planning of concept, attractive points and location selection works are on going based on evaluation of various parameters of each site.

3) Construction plan of an **Oil Refinery** is formulated at Lamu in consideration of expansion of the existing Mombasa Refinery, probable construction of refineries at Uganda, possible sources of crude oil (from Southern Sudan), production plan with a capacity of about 150,000 barrel per day, and possible consumers and sales areas.

14.2 Important Issues and Subjects to be Taken into Consideration

Major issues to pay attention in this Study at this stage can be summarized as follows:

14.2.1 LAPSSET Corridor Project

(1) Prerequisite of the Project

This LAPSSET Corridor Development Project as well as new Lamu Port Construction Project, or this Study itself, predicate on sound and sustained economic growth of the neighboring three countries, i.e. Kenya, Southern Sudan and Ethiopia.

It is recognized that **independence of Southern Sudan**, which will be realized possibly through the Referendum scheduled on 9th January 2011, is the prerequisite for the Project, especially for the Pipeline Project.

(2) Coordination with Southern Sudan and Ethiopian Governments

Existence value of the LAPSSET Corridor depends heavily on users in Southern Sudan, especially cargoes including crude oil. In view of start of operations of the Corridor, **cooperation with the Southern Sudanese government** and the Kenyan Government is very essential in creating demand and supply.

(3) Fund Arrangement for Corridor Development Projects

Realization of the LAPSSET Corridor Project, including development of Railway, Highway and/or Pipeline is depend entirely on fund and budget availability. The former two facilities can only been realized by **proactive involvement of the government** or **public sector**. Pipeline development has been usually made through **private investment**. Confirmation of policy on fund arrangement and investment method are essential for the project formation.

14.2.2 Lamu Port Project

(1) Relocation of the Navy Base at Manda Bay

The Manda Navy Base and the Air Force Airstrip located on the west coast of Manda Bay can co-exist with the new Lamu Commercial Port during the initial Urgent Plan Stage. It is, however, difficult for the commercial port to be expanded and operated efficiently, following expected increase in cargo throughput until 2020, if the Navy Base will remain sandwiched permanently. The only appropriate countermeasure is to ask the government to relocate these military facilities to some other place. The timing of relocation is not now, but before 2020 when the port will be expanded until nine berths will have been constructed to the south of the Navy Base.

(2) Development of Existing Access Road from Garsen to Lamu

Parallel to development of new Lamu Port at the western coast of Manda Bay, it is indispensable to develop the existing road connecting Lamu to Garsen, i.e. **Route No. C112.**. The road is currently narrow and most of the part is not paved with many bends. It is under management of *the Kenya National Highways Authority.* It is necessary to improve the road by widening the road width, strengthening the pavement, and improving drainage and other utilities, which should be completed before opening of the new port.

(3) Planning of Fishing Port Facility for Fishery

A port facility is planned for **fishing industry** including wharfs, slipway for repair, market facility and others, responding to strong request of the regional District Commissioner. The facility is planned at Mokowe at the Urgent Stage. After development of urban areas behind the port areas on the west coat of Manda Bay, the fishing port can be relocated to the north of the Commercial Port.

(4) Development Policy of Port-related Industrial Activities in Lamu Port

In order to enhance future development of various industries in and behind Lamu Port, and contribute to regional socio-economic development, **new port-related regional development policies** could be discussed to be adopted, including "free port (FP)," "export processing zone (EPZ)," "Special Economic Area (SEA)," and others. Petro-chemical industry is another field of interest to be developed, making good use of crude oil, parallel with development of the Port.

(5) Development Policy of Port Metropolis behind Lamu Port

It is expected that, if the development of LAPSSET Corridor, Lamu Port and Marine Resorts will be successfully realized, the population of **the new Lamu Port City** could become 1.25 million persons, which is larger than the present population of Mombasa. Then, it is indispensable that expansion of this urban area is to be regulated properly from the beginning of city formation by means of appropriate urban development policy, backed up by social, physical, institutional, welfare and financial policies, by the central and county governments.

(6) Difficulty in Mixture of Port Users, i.e. Large Trade Ships and Small Local Ships

New Lamu Port will be located in Manda Bay where local fishing boats and speed boats for tourists will also enter to the harbour area frequently. There are possibilities to encounter collisions between the large commercial ships calling Lamu Port from abroad and such small local boats. In order to forestall **marine accidents** in the harbour, a new port management system such as Vessel Traffic Services (VTS) is required.

14.2.3 Plan of the Other Components

(1) Coordination with Related Ministries in the Governments

It is important to coordinate and cooperate with **related Ministries and/or stakeholders** in promoting and executing the projects of the other components. An example is the Resort City planning at Isiolo, which has been executing by the Ministry of Tourism. The planning work is duplicating with this study. The study stage is also similar. It is important to cooperate with each other.

(2) Co-funding for Multi-sector Projects

For sustained development of Lamu Port, it is essential to incorporate related projects such as electricity supply and water supply, or construction of electricity plants and pipeline from the Tana River, not only for the port, but also for development of different kind of industries such as agriculture. This type of **multi-sector projects** should also be sought in this Project..

14.3 Recommendations

Based on the above study results and discussions, the Consultant would like to submit the following recommendations to the government of Kenya:

14.3.1 LAPSSET Transport Corridor

(1) Consideration on Environmental Conservation

From the viewpoint of environmental conservation, the LAPSSET Corridor, or railway, highway and pipeline must have remedial measures for their impacts on wild animals and domestic animals and their lives. An example is influence of their construction to migration/movement of these animals across the facilities. The corridor shall not block it completely. It is necessary to construct culverts and/or other appropriate passages across the corridor bank.

(2) Consideration on Electricity Supply System

For LAPSSET Corridor projects, electricity supply could become a serious bottleneck. According to "Kenya Electricity Access Investment Prospectus 2009-2014" by the Ministry of Energy, electricity supply will be increased by import of surplus electricity from Ethiopia, geo-thermal power generation, and wind power generation.

In case of LAPSSET Corridor, the Crude Oil Pipeline from Southern Sudan to Lamu, for example, requires eight booster pump stations with a capacity of about 200MW in total. Thus, the pipeline project will not be realized unless a Power Supply Project will be implemented parallel.

14.3.2 New Lamu Port

(1) Authorization of Port Master Plan and New Lamu City Plan

Prior to commencement of construction works, the following plans shall be authorized by the government of Kenya administratively, legally, and financially:

1) Lamu Port Master Plan

Definition of Lamu Port area, Free Port area, Bonded area, Layout plan of port facilities, etc.

2) New Lamu City Development Plan

a. Authorization of **new Lamu City Development Plan**.

b. Land management by prescription of "**Urban Area.**"

c. Designation of Port-related Industrial Area, **Special Economic Zone** (SPZ), Export Processing Zone (EPZ), etc.

d. Authorization of location and area for **New Lamu International Airport** and **Resort Cities**.

e. Other infrastructure development plans such as **Electricity Supply Projects** with an order of 1 GW for 1.25 million citizens and factories anticipated in 2030.

(2) Establishment of New Lamu Port and Port Management Body (PMB)

1) Establishment of New Lamu Port

"Lamu" is already defined as a port in Kenya under the management of KPA by "the Kenya Ports Authority Act (Article 2)". It is necessary, however, for the Minister of Transport to define "**the Limit of Lamu Port**" (Article 34 in the Act) in order to apply *compulsory pilotage* in consideration

of importance of safety of ship operations in the harbour. "**The Land Area of Lamu Port**" shall also be clarified under "the National Land Policy" to define the boundary of the port.

2) Establishment of Suitable Port Management Body (PMB)

The Port Management Body (PMB) of Lamu Port is KPA as the statutory body defined under the description of the present KPA Act (Article 12).

However, confirmation of suitable institutional, legal, and financial arrangement for the PMB, e.g. ***Lamu Port Authority,*** is urgently required for smooth implementation of the port construction project and appropriate execution of port management and operations after opening of the port.

A possible institution is the subsidiary company of KPA for the initial stage of the port development. The major reason of this arrangement is to consolidate financial background of the authority and the project. The Authority can be expanded and privatized in the future by inviting port users into PMB managements, e.g. sharing the stocks by KPA (51%), shipping lines and terminal operators (30%), and other port users (19%).

In any case it is important to create or confirm the PMB and establish its organization and staffing.

3) Immediate Works to be Done by the PMB

The PMB has many important and urgent works to be done for the Project, including:

a. **Coordination with the related organizations and stakeholders** for promotion and administration of the Project, including the central and local governments,

b. **Technical and financial management** of the Project,

c. Execution and management of other **contracts for construction, procurement, operations, etc.** of new Lamu Port,

d. Implementation of **Land Acquisition** and **Resettlement,**

e. Execution of **EIA monitoring** during the execution period of the Project

f. Institute necessary regulations, including the new **Tariff Book**, etc.

g. Preparation for opening of the port, starting operations and maintenance, including establishment/employment of **Terminal Operator(s)**, and

h. Others.

(3) Construction of First Three Berths

1) Employment of Consulting Firm

In order to execute the Project under *the Engineering, Procurement and Construction Contract* (EPCC) with a contractor smoothly and successfully, it is indispensable for the Project Owner to employ a capable consulting firm for the construction supervision and other assistance works for the Project.

2) Additional Geotechnical Surveys

There are several site surveys to be carried out before execution of the construction works such as quarry survey. One of the most essential surveys is the geotechnical survey. As the foundation layer of the planned wharfs in the sea is hard, i.e. hard weathered coral rock layer, which appears at depths from CDL – 12m to -36m with considerable undulation, it is necessary to undertake additional geotechnical investigations in order to confirm the bearing depth of piles and prepare safe execution design of quay structure. For this purpose soil boring at intervals of 50m along the face-line of the quay wall shall be conducted during the mobilization period of the construction contract.

3) Selection of Type and Size of Dredgers

Dredging of seabed and reclamation of port area is the most essential civil works in this project. Dredging at Manda Pass is hard coral rock dredging. Dredging of channel and basins in Manda Bay is sand and coral rock dredging. The volume of dredging amounts to about 11 million cubic meters in total. Question is suitable method and equipment for coral rock dredging.

It is planned in this report that the rock dredging and reclamation works can be done basically by Cutter Suction Dredgers of high capacity (total power per dredger must be 4,000 HP or more) with hard cutter head blades. There could be other type dredgers, however, which should be introduced for a certain part of dredging works such as Backhoe Dredgers and Grab Dredgers for sloped portion of rock dredging.

Selection of most suitable type and size of dredgers should be done carefully by the contractor based on laboratory tests of coral rock samples taken from the site by themselves.

4) Usage of Dredged Rock for Embankment of Wharfs

The dredged material at Manda Pass will consist mostly of coral rock. It is to be used as the body of the embankment of wharfs of the initial three berths.

5) Control of Fluid Mud not to be Discharged from Reclamation Area

In carrying out reclamation work at the wharfs of the three berths by sending dredged materials from the channel and basins in front of the berths to the reclamation site through a discharge pipe by means of water pumps on Cutter Suction Dredgers, it is essential to carefully manage the fluid mud caused by discharged water not to flow out from the reclamation area. This is to prevent diffusion of mud on the seabed from the viewpoint of environmental conservation.

(4) Navigation Safety Measures

Among various subjects to be clarified before implementation of Lamu Port construction, navigation safety measures at channels, Manda Pass and basins in Lamu Port, should be considered by PMB as a top priority project to ensure safe navigation large international trade ships as well as small local ships, including Dhows and speed boats. They include introduction of **Vessel Traffic Services (VTS)** and **Automatic Information System (AIS)**, etc.

(5) Preparation for EIA Procedures

In order to start construction of Lamu Port, it is mandatory to carry out **Environmental Impact Assessment (EIA)** and to obtain **the EIA License** from NEMA. It is recommended that the Project Owner, i.e. MOT, will apply for the procedure to NEMA immediately after the construction plan, including the layout plan of Lamu Port, will be authorized by the government of Kenya. In addition, it is necessary to hold "**the Stakeholders Meetings**" twice at the site, formulation of "**Resettlement Action Plan (RAP)**", and budgeting for and execution of the **Compensation for Project Affected People (PAP).**

(6) Construction of Symbol of New Lamu Port and Metropolis

The Lamu area will become a Metropolis based on development of new Lamu Port as the distribution center, Resort City as the core of tourism sites, and port-related industries. It is recommended to construct **a symbolic facility** of the port and regional development for the visitors to the port, tourists, local residents and port workers. A candidate facility is the Port Administration Building. It should be designed artistically, and free access to the top observation floor and restaurants should be guaranteed to the public.

(7) Procurement of Minimum Required Cargo Handling Equipment

In order to ensure smooth start of port terminal operations, it is recommended to prepare the minimum kind and number of basic cargo handling equipment, e.g. two SSG and 4 RTG for container, and one Mobile Crane for general cargo handling, to be procured by the Project owner in the initial construction contract of the Project.

14.3.3 Associated Infrastructure

(1) Access Road Construction

It is prerequisite to improve the present Route C112 road at least before opening of the new Lamu Port. It is desirable to complete it before start of construction works, or even during the port construction works, to utilize the road for construction and logistic works for new Lamu Port. For this purpose, discussions between the owner of the Lamu Port Project and the Kenya National Highways Authority should start as soon as possible.

(2) Electricity and Water Supply

In the Urgent Plan, electricity and water supply to the first three berths and the related facilities and equipment is planned to be done by two generators of 3,500 kVA to be newly instilled in the port, and through the existing water pipeline. It is apparent that, following the development of the port, their capacity will become not enough and new sources shall be exploited. For this purpose, the planned extension project of 220kV power supply line from Kilifi to Lamu by the Kenya Power and Lighting Company, Ltd. (KPLC), and water supply projects by the Tana River Development Authority (TRDA) should be carefully followed up.