UNITED NATIONS TRANSPORT AND COMMUNICATIONS DECADE IN AFRICA, 1978-1988 (UNTACDA)

HANDBOOK ON
SELECTION, PROCUREMENT, MAINTENANCE, SAFE USAGE AND PRODUCTION OF PORT CARGO HANDLING EQUIPMENT IN AFRICAN PORTS

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Forward

The need for a HANDBOOK concerning selection, procurement, maintenance, management, safe usage and production of cargo handling equipment in African ports was indicated and considered as an important area of concern by the Transport, Communications and Tourism Division of ECA since the launching of the Transport and Communications Decade for Africa in 1978.

As a result, in phase I and II of the Decade programme there were port projects related to selection, procurement and maintenance of Cargo Handling Equipment. The World Bank, United Nations Conference on Trade and Development (UNCTAD), International Cargo Handling Co-ordination Association (ICHCA), International Labour Organization (ILO) etc. have also given importance to cargo handling equipment maintenance problems in African ports and have published documents.

This Handbook deals mainly with suggestions of selecting, purchasing, managing and maintaining of port Cargo Handling Equipment in African ports and the objective is to increase the awareness of African Governments and Port Authorities to the serious consequences of equipment mismanagement and to provide guidelines of efficient Port Equipment Management Techniques in order to increase port efficiency and ensure a more productive use of scarce resources.

Economic Commission for Africa is pleased to prepare this HANDBOOK and hopes that it will be of some use for African ports.

M. Bongoy, Chief
Transport, Communications and
Tourism Division
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CHAPTER I

Background Information and Introduction

Need for port equipment in view of new cargo handling methods developments

The need for port equipment and cargo handling methods in African ports is the result of shipping demands.

The change from manual to mechanical handling which has taken place in port industry is mainly due to modern cargo handling equipment especially Forklift Trucks which became available in late 1940's. This is also true with manufacturing organizations, because with the advent of the forklift truck, they improved their packing systems. By employing the machine with pallets, cargo could be picked up, conveyed and stacked at the same time instead of package by package at a time. The method quickly became so popular that goods were handled as palletised loads not only in factories but also when distributed. This brought in turn that common carriers such as road, rail and even water transport contractors to alter part of their vehicles to suit the new traffic. Storage facilities started also to be built in accordance with demands and types.

Traditional manual cargo handling methods have given way to mechanization which is costly and sophisticated. Mechanization of port equipment is due to the ever growing traffic through ports, of the nature and weight of such traffic and also by the special technological requirements of ships that carry the cargo.

This Handbook therefore attempts to advise African Port Authorities on the following fields:

- basis for selection cargo handling equipment,
- management and organization of equipment maintenance techniques,
- maintenance and safe usage of cargo handling equipment in African ports,
- production of cargo handling equipment and their spare parts.

Revolutionary changes are taking place in African ports mainly due to the repercussions of changes that take place in shipping, packing systems, handling and transporting methods in the world and the employment of various mechanical handling equipment such as forklifts, and cranes on quays, transit sheds etc.

The presence of various cargo handling equipment in a port is much influenced by nature and quantity of cargo, ship requirements and change in methods due to rapidly changing technology. The port industry has obviously shifted from labour intensive to capital intensive functions which involves ports with additional costs.

In the last 20 years, there have been many changes in cargo handling techniques. Up to the early 1960's most general cargo was carried in what we now call "conventional" vessels and shipowners became more interested in storage of
cargo aboard ship for more profits. Palletization, cargo on skids, lighters aboard ships (lash), ro-ro and containerization etc. were introduced.

Between 1960's and now African ports have had no choice but to accept these changes in cargo handling methods. In most cases the degree of adaptation to such changes was not fast and most ports are still served by a mixture of conventional vessels. What was the speed of adaptations, change in size of cargo units, meant upgrading of cargo handling equipment. It was no more possible to depend on ships’ derricks but bigger cranes ashore have to be introduced now. Now shore equipment have to match modern cargo-units system and be able to lift heavy lifts between 5-30 tons capacity.

Most of the African ports, because of shortage of capital and maintenance problems, are unable even today to meet demand for equipment. In order to address this problems, African ports have to eliminate shortage of capital and spare parts, have good policy of preventive maintenance, rationalize equipment purchasing policy, exercise better daily equipment utilization etc.

Most of the African ports are either small or big, and two common factors amongst them are that they own modern cargo handling equipment and also employ large numbers of dock workers. Another relevant factor in African ports is the availability of cheap labour while equipment is not and this calls for the right combination of labour and mechanization and rational utilization of equipment and labour. In conclusion it can be said that all these stress the need for both technical and economic research into the various types and makes of mechanical port equipment now available and well established selection, procurement and maintenance policies.

The increasing unitized nature of cargo in modern shipping has completely changed the requirement of cargo handling equipment in ports and this has enabled more and more researches to be undertaken for expansion. The effects of cargo handling methods changes in African ports will be far reaching, affecting not only handling methods but also port layout and premises design and ultimately, even ships design.

The rapid introduction of modern cargo handling equipment in African ports has committed the African ports to regularly maintain cargo handling equipment in their ports and to closely follow-up planned maintenance policies.

Good maintenance policies in ports for cargo handling equipment would require the indulgences of all concerned in ports and it should be an effort of many sides. First and foremost it requires the setting of adequate and appropriate objectives, that would determine policies, resources, training, workshop facilities, spares, materials and equipment. The same objectives should include the setting again of an effective organization with a good controlling system.

The main objectives of Maintenance of Cargo Handling Equipment is to extend the life of the various mechanical equipment in ports so as to provide adequate number of these equipment for production. By production in this context we mean efficient port productivity and quick ships turn-round time with safety for ships, cargo and safety of personnel working around ships and cargo. In other words the aim should be to achieve optimum speed of operations, with care for cargo and safety of personnel.
Currently Africa is serviced by a mixture of variety of cargo vessels varying from conventional cargo ships to full container vessels, palletised vessels and bulk carriers. The evolution of cargo units has brought a considerable effect on cargo handling operations and on equipment itself. In the 1950's and 1960's most cargo handled in African ports were bagged, loose cartons, bales etc. and cargo handling operations were carried out using ships derricks. These cargoes in those days were moved from ships side to the sheds by small forklifts, pallet or bales lifters or hand trucks. As cargo units increased in size, the need for shore cargo handling equipment changed.

Technological changes in the shipping world has compelled African Governments to spend some of their hard-won foreign resources for the purchase of expensive and sophisticated cargo handling equipment for their ports. Such expensive equipment must be appropriately maintained and fully utilized. Through proper use and adequate maintenance system the life span should be extended as frequent replacement would be an expensive affair.

African port Authorities therefore, are urged to set-up appropriate maintenance machinery for cargo handling equipment in their ports. l/. a,b,c and d.

Chapters II, III, IV and V deal with suggestions on selection, procurement, Management policies of Cargo Handling Equipment for African ports and African Port Authorities are free to use some or all suggestions if they find them applicable to their port systems.

1/ (a) Technical and Social changes in the worlds of ports 1971. ILO, Geneva.
(c) Procurement, Management and Maintenance of port equipment- particular reference to Mombasa port - 1980, office of Managing Director.
CHAPTER II

Selection, Procurement and Maintenance of Port Cargo Handling Equipment.

a) Selection

Appropriate selection of the right type of equipment is an important factor in dealing with port cargo handling problems. If selection is not done properly this can result in the Port Authorities having spent unwisely. In selecting port equipment one must bear in mind obsolescence and the need for changes especially due to rapid changes in technology. Maintenance and spare part problems should also be considered. Any Port Authority must ensure that it has the right type of equipment.

It is believed good that a port establish a committee composed of Engineering, Accounts, Purchase, Operation, Navigations, Management, Departments for selection and purchase of cargo handling equipment.

(i) Check-list

In order to determine the ideal port equipment, it is essential, first and foremost, to draw a long check-list and one is suggested below for consideration.

- the need for the equipment,
- nature of the cargo and suitability of the equipment,
- the work the equipment is expected to do (type, quantity, quality),
- capacity of the equipment and general performance,
- source of power considering the environment in which the machine will work,
- safety of the operator, of the equipment itself, the ship, other public and harbour property including personnel,
- the geographical lay out of the port,
- operating speed and breaking ability,
- local availability of spare parts,
- obsolescence and replacement against rapid technological changes,
- shift working and working conditions (climate, weather, heat, wind etc.),
- user/manufacturer consultancy services,
- serviceability, particularly of simple routine checks,
- reliability and durability,
- acceptability, likeability by the operator including comfort, easiness when operated and maintained,
- visibility,
- purchase, rental and hire contract alternatives,
- training of personnel,
- increased cost with age and overall cost,
- proper specifications and design.

Preparing a check-list might look easy but going through such a list and giving the right answer may be difficult. However, its availability has an advantage and African port Authorities are urged to have a check-list of this nature.

With the help of the check-list drawn by each port Authority for its own selection of Cargo handling equipment, it must try to arrive at the right conclusion of selecting and purchasing a machine. The question of how many (quantity) machines a port should purchase and operate depends on the amount of work to be performed and the type of cargo the port is expected to handle. To determine the amount of work a port may perform, many port authorities agree that the idea of dividing a port into Operational zones or Sections would help. The amount of work planned to be performed in an Operational zone or Section would determine how many for e.g. forklifts or quay cranes would be required in a given time and for the whole port the different operational zones or sections will be added up to get the full number.

In selecting the right type and number of cargo handling equipment in a port, there should be many questions to be asked and answered by the purchasing committee established to undertake proper selection of equipment. The following should be carefully examined:

- the design and capacity of the machine,
- general performance, flexibility and attachment, whether the machine should be able to do more than one kind of job (multipurpose).
- source of power considering especially the environment in which the machine will work (limitation) to work on board ships, in fire risky areas and fumes may contaminate special sensitive cargo,
- safety problems for ships, cargo, the operator and the equipment itself is also important factor to be considered;
- geographical lay out of the port and its other physical characteristics must be considered as well relevant to these are speed and breaking abilities,
- visibility is a critical characteristics since a port is full of all sorts of sizes of cargo and other erection,
- design of the machine should satisfy the requirements of operators; machines such as forklifts and mobile cranes handle both easy and difficult cargo. They move forwards, backwards and sideways and in doing so the design of the machine must satisfy the requirements of the operator and of the cargo.

- comfort and acceptability of operator and ease of operation; this important point should not be ignored.

- Serviceability of the machine particularly of simple routine checks; a machine, by its own good design should render itself to easy serviceability. Some models are so complicated that even experienced maintenance staff find them difficult to service then.

- durability of the machine; this depends of course on how the machine is handled, operated and maintained. However, the machine itself should be strong.

- Spare parts; whether a model is old or new, a port must ensure there is adequate local availability of spare parts before or during the purchasing of a machine.

In selecting port equipment the purchasing committee must bear in mind obsolescence and the need for changes especially due to rapid changes in technology. As a result, the life of mechanical handling equipment in ports is becoming shorter despite the high costs involved.

Together with the different criteria to be considered for purchasing port equipment by a committee, two important relationships and dealings with the manufacturer or his agent should not be forgotten. They are consultancy and technical services to be provided by the manufacturer or his local agent for the equipment purchased and training services to both operating and maintenance staff of the buyer by the manufacturer or his local agent. These two elements should be part of the deal.

(b) Procurement procedures

When selections of the type of equipments to be purchased are made, procurement can be done in any of the following methods.

(i) tendering or

(ii) negotiations or

(iii) by direct purchase depending on the circumstances prevailing.

The tendering method involves pre-qualification of manufacturers or suppliers, selection of the manufacturers/suppliers, invitation to tender, the receiving and opening of tenders, assessment of the tenders, awarding of the contract and finally taking of delivery.
The negotiation method involves slightly less procedures as it includes selecting of manufacturers, negotiation, assessment of offers, award of contract and take of delivery.

**Acquisition by direct purchasing** method involves selecting of the manufacturer/supplier, negotiation over purchase price, the actual purchasing and taking delivery of the equipment.

Which method is the best depends on the circumstances prevailing during the purchase and the management should be flexible. However, the tendering system has an advantage over the others in that competitive prices are offered and the management is able to choose the least expensive equipment.2/

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CHAPTER III
Organization and Management of Equipment Maintenance techniques

In recognition of the increasing importance of equipment maintenance in African ports, Port Authorities and undertakings in Africa should carefully handle the problem. In fact central Governments should take special interests in the field and regular supervisions and controls of maintenance methods should be made.

The responsibility for maintenance of equipment in a given port may rest on the chief Engineer as in charge of the over all infra and super-structures installations or shared between civil, mechanical and electrical engineers where there is no overall chief Engineer position.

Nevertheless, the top management including the chairman and through him the Board of Directors and the Managing Director/General Manager etc. should closely follow-up maintenance programme and review objectives of maintenance of equipment and other structure when ever required. It should not be a task to be completely left to the Chief Engineer or an established maintenance committee as the case may be in some ports.

There are usually "small" and major maintenance problems in ports where the "small" ones should be handled by the port and the "Major" ones should normally be offered to contracts.

In the organization and Management system of equipment maintenance, the following sections are suggested to be considered.

(a) Preventive maintenance

A preventive maintenance scheme should be designed and implemented. It is the implementation of basic scheme available with firm commitment to actually do something. The commencement can be with a pilot project for example, forklifts or mobile cranes etc.

It should not be the case that repair of port cargo handling equipment should take place when ever and at the time when there is a break-down. Some sort of maintenance programme to be regularly followed on each mechanical equipment in port should be designed and worked out before any break-down on the equipment takes place.

(b) Maintenance required during operations

Operations maintenance, as it is sometimes called, is often performed by the operator of the equipment and this include checking fluid levels, tyres, batteries, listening for unusual noises, noticing excessive smoke, looking oil leak etc. The operator has to check some of these problems before the start of the work and after shut-down or during the operation itself.
(c) **Quick maintenance response to port equipment failure**

Modern sophisticated ships are operationally expensive and do not wish to stay in ports more than the required time. Otherwise, they become expensive. To avoid inconveniences to ships in ports, port authorities should prepare themselves to meet the requirements of ships in their port including cargo handling equipment. Breakdown maintenance is the most critical type of maintenance especially for high speed equipment, and the down time of such breakdown is also critical. Container and other fast-moving ships are only in ports for few days and a few hours loss can be a significant percentage of operation time and can also affect schedules at other ports if the ship sailing is delayed because of such breakdowns. In this connection, response time to maintenance is very important.

(d) **Modification of equipment**

Some of the type of maintenance require modification of equipment and this is carried-out in workshops. With the good combination of skilled manpower and the required workshop machines, the results of such modifications are highly appreciated. However, before making any modifications, all the implications should be studied. Modifications include design improvements, safety improvements, and other occasional miscellaneous changes on the equipment.

(e) **Organizational side of port equipment in ports, management of maintenance and repair services, and essential facilities are important.**

Management of maintenance and repair services include everything from policy, supervision, skilled manpower (training) etc. to workshops, tools, spare parts, equipment organization, equipment monitoring etc.

It is an important field of activity that port authorities should deal with if proper utilization of cargo equipment in ports are to be achieved. If because of inadequate management of maintenance and repair services, cargo handling equipment in ports are not mobilized at a given time, the situations will lead to low productivity of port performances in general leading further to greater loss of traffic to the ports.

The most essential part for technical work of cargo handling equipment in ports is a well-equipped organized workshop. Its location and layouts should be properly studied and planned. The tools required for the workshop and the trained manpower should be constantly reviewed and updated.

In the field of equipment organization and established inventory, equipment registry, codification and equipment standardization systems should be followed. Statistics for optimum daily operating is also essential to be kept.
CHAPTER IV

Safe usage of cargo handling equipment in port

Cargo handling in port, dock or wharf areas, whether in board or out-board, requires that each operator playing a part in the many functions should keep the following points always in mind:

(a) safety of personnel.
(b) safety of the ship,
(c) safety and the condition of the cargo,
(d) economic and rapid turn round of the ship, vehicles tractors/trailers etc.,
(e) rapid and efficient disposal of cargo from the transit area.

Port Authorities in Africa should provide the basic safety requirement training opportunities to their Dock-workers as laid down by International Labour Organization (ILO) and by National regulation. It is equally important to put all those marks and signs that could eliminate, prohibit danger in ports.

Some of the ILO safety provisions in cargo handling in ports that port Authorities should follow are:

(i) special training to forklift drivers regarding not overloading and safe handling of the equipment.
(ii) establishment of clear traffic rules and warning signals in ports,
(iii) laying down safety rules that prohibit for example passengers riding empty or loaded forklifts, mobile cranes etc.
(iv) rules for stacking of cargo in stores, transit sheds, port area etc.
(v) follow-up of maximum weight Recommendations of 1967 - "The packaging of loads which may be transported manually should be compact and of suitable material and should, as far as possible and appropriate, be equipped with devices for holding and so designed as not to create risk or injury”.
(vi) attention to be taken if the use of petrol - driven forklift trucks in the holds of ships is used; Electric driven forklifts are safer to be used in ships holds.

It is not possible in this report to cover all the general safety provisions to work in ports. ILO has devoted much time on this and has published a lot of publications and passed conventions on safety measures to be studied and observed both by port Authorities and Dockers. It is adequate to mention the Convention On Protection Against Accidents (Dockers) of 1932.
Dockers and other port employees working in various fields of port activities are advised to strictly follow safety measures while working in ports. Failure to do so may result in fatal injuries to them leading to loss of their lives. Therefore, Port Authorities are required to be reminding them from time to time and take actions on those not following.

An important element that should be considered with cargo handling equipment maintenance problems in African ports is Training. The Development of a training programme for cargo handling equipment maintenance in African ports is equally important as the maintenance itself and high priority should be placed on.

Part 1: Aid Memoire
Part 2: Back-up Material
CHAPTER V

Cargo Handling Equipment Production in Africa

The main objective of the Lagos Plan of Action for the implementation of the Monrovia strategy for the Economic Development of Africa adopted by the Heads of State and Government of OAU, is to promote self-reliant and self-sustaining integrated economic and social development at the national and multinational levels in order to satisfy the basic needs of the people of Africa. To attain this objective, one of the factors would be the proper utilization of indigenous resources.

The Industrial Development Decade for Africa, 1980-1990 has also an objective of attainment by Africa of 1.4 per cent of world industry output by 1990 and 2 per cent by the year 2000.4/.

In the Global Strategy of the Transport and Communications Decade for Africa 1978-1988 it is emphasized that promotion of African industries in the field of Transport and Communications equipment should be encouraged.

These and other objectives should encourage African port Authorities to assess their equipment requirements and try to produce some of them in their own ports. When we say port cargo handling equipment they are many and diversified. The list can include ordinary traditionally used equipment such as cargo trays, slings, grabs, pallets, cargo nets, vehicle - lifting gear, heavy lifting beams, different types of hooks, shackles etc. to sophisticated equipment like container - Ro/ro and bulk cargo handling equipments.

This introductory paper deals with two suggestions of approaches of how port cargo handling equipment manufacturing be considered in Africa at present. These approaches should be developed to enable to lead to the manufacturing of high standard and sophisticated cargo handling equipment in Africa in the future.

(a) Production of cargo handling equipment such as grabs, nets, slings, hooks, gears, pallets etc.

Africa is still serviced by a mixture of dry cargo vessels varying from full container vessels to vessels which carry a limited number of containers, palletised cargo and a considerable amount of merchandise which cannot be economically carried in containers. The calling of 'Conventional' vessels to African ports will continue in the future.

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African countries may not be expected to produce sophisticated and high standard type of cargo handling equipment at present. For sure, such planning would require high investment in trained manpower. Nevertheless, genuine start can be made with manufacturing cargo trays, different slings, grabs, pallets, different cargo nets, different gears, hooks, sheekles etc. No big investment requirement is there and such activities can be carried out in the workshops of Port Authorities.

These types of cargo handling equipment have been in use in African ports from early days and their functions during loading/unloading operations cannot be ignored even today. They are extensively used in "conventional" ships that still call in African ports in a large number (about 80 percent) and vessels such as barges, lighters, dhows etc. Though modern sophisticated vessels such as cellular and Ro/Ro are gradually increasing the number of their calls in African ports, many years have to pass before "conventional" ships and vessels such as barges, lighters, dhows completely stop from calling at African ports.

Hence, the importance of the manufacturing of some of the traditional equipment.

African ports are therefore advised to encourage the manufacturing of such equipment in their workshops and save the foreign currency drain in this field.

The immediate objective is to provide such equipment to their ports. But the long term objective is to lay down the tradition and infrastructure to enable African ports to manufacture high standard and sophisticated cargo handling equipment such as Forklift Trucks, Mobile and Floating cranes etc. in the future.

(b) Production of spare parts for cargo handling Equipment

Highly sophisticated cargo handling equipment used in African ports today are purchased at high costs. Since their purchases are made from developed countries the involvement of foreign currency is there. A Gantry crane costs about US$5 million. A 20 footer Forklift Truck and similar capacity Mobile crane costs about one million dollar each. A Quay crane of 5 tons capacity costs around $0.3 million. Forklifts of 3-5 tons capacity are about $0.1 million. Straddle carriers, high powered Tractors and bigger capacity Trailers are neither cheap. A straddle carrier costs over a million dollar. 5/

5/ Port problems in Eastern/Southern Africa subregion 1986 P.C. Bakilana
In the last 20 years, there have been many changes in cargo handling techniques. Up to the early 1960's most general cargo was carried in what we call now "conventional" vessels and shipowners looked more to storage of cargo abroad ship for maximization of their profits. Ship crew and port charges were inexpensive. But with increase in port labour costs and decline in port productivity in developed nations, shipowners quickly turned to maximization of utilization of ship-space and reduction of operating costs. Suddenly cargo presentations had to change. Palletization, lighters aboard ship (lash), cargo on skips, ro-ro and containerization were introduced. Ship design was changed to meet new requirements.

Between the 1950's and now, developing ports have had no choice but to accept changes though the pace of adaptation to change was not fast. Change in size of cargo units, however, meant upgrading of cargo handling equipment in ports. Lack of capital did not allow most of the African ports to provide the required type of cargo handling equipment. In order for African port authorities to address this problem, they need to eliminate shortage of capital and spare parts, streamline preventive maintenance, rationalize equipment purchasing policy etc.

One of the measures African port Authorities are advised to undertake therefore, is to establish well organized workshops in their ports so as to increase the life span of their expensive equipments they are buying in foreign currency for their ports.

These workshops, apart from what are expected to maintain all cargo handling equipment, should be equipped to produce some of the spare parts these equipment may require from time to time. It will be an expensive affair to import all spare parts from abroad and they involve foreign currency. With the proper type of machines and trained technicians some of the spare parts for example of Forklift Trucks, Mobile cranes etc. can be produced at local workshops from those metals and disposed iron.

(c) The other function of a well established workshop in African ports should be Modification of equipment. Modification of equipment include design improvement, safety improvement and other necessary changes on the equipment.

There are reasons why an equipment may need modification. Maybe there is an intention to increase its lifting capacity like providing additional fork in a Forklift Truck or reducing the number of forks from it. A mobile crane may get older and its capacity reduced. In order to prolonge its services some modification of reducing the capacity of lifting gears or beams may be required.

With the good combination of skilled manpower and the required workshop machines, modification of cargo handling equipment in ports are necessary. The most important thing however, is that before undertaking any modification all the implications should be studied and considered. 6/

6/ Cargo Handling Equipment Japan 1975
CHAPTER VI

Conclusions and suggestions

The basic cargo handling equipment maintenance problems in African ports are mainly due to lack of policies, inadequate allocation of funds, lack of training and trained manpower, inavailability of spare parts, lack of appropriate organizational set-up etc.

Ports are gateways serving hinterlands of Nations to which they belong or zones they attract even outside of National boundaries. In other words they are the links between land and sea transports the major function being offering a range of services of which one is essential - the transfer of cargo from one mode of transport to the other.

The main pre-requisite for a port in order to be able to carry-out its functions is therefore, the provision of both infra and super-structures. The provision of adequate number and type of cargo handling equipment is an important factor in Port industry. Along with such provisions, maintenance policies and every arrangements towards the attaining of good maintenance policies is highly desirable. In short, the objectives of policies of African port maintenances should be able to address itself to the problems mentioned in the previous chapters so as to improve the quality of maintenance.

The ECA list of cargo handling equipment maintenance projects mentioned in the UNTACDA programme is not exhaustive. At the same time individual African ports should have their maintenance programmes and policies and have to implement them.

Developing African ports suffer from lack of capital for acquisition of cargo handling equipment. At the same time new advancement of technology in the field of International shipping demands more sophisticated and expensive equipments to be provided. African ports have no choice but to accept the various evolutions that take place in cargo systems in ports and provide equipment at any cost.

It is true that there are many ports in Africa because of shortage of capital and maintenance problems are unable to meet demand for equipment. This problem should be avoided by any means and for ports to address such problems, should provide capital for equipment and spareparts, have good policy for preventive maintenance, rationalize equipment purchasing policy, exercise daily planning of equipment utilization.

So often it is considered that lack of cargo handling equipment and cargo handling problems are mostly influenced by lack of capital, maintenance policy, lack of trained manpower etc. Even if such factors are easily resolved and the necessary type and number of equipment are available, the required port productivity rates could not be achieved mainly due to lack of supervision and management follow-up. Instructions are often given through a memo or verbally and too many supervisors and managers that is enough. They consider the instruction is implemented. Such instructions do not have follow-up, no reporting back and no action taken if instructions are not carried out.
On many occasions, management is out of touch with operational procedures and maintenance programmes, a case which should not happen. In African port authorities, from top to the lowest concerned man about equipment and their maintenance, should be aware of equipment and maintenance problems and form a chain of supervision and follow-up at all times.

The Transport and Communications Decade for Africa, programme, 1978-1988, has placed special importance to maintenance and rehabilitation programme of transport infra and superstructures in Africa including cargo handling equipment.

In phase one of the Decade programme, 1980-1983, there were 120 port projects out of which there were few port cargo handling equipment maintenance projects. In phase II of the same Decade programme 1984-1988, however, by placing special importance to cargo handling equipment maintenance problems, 17 projects are identified at an estimated cost of US$ 249.60 million. This is about 25 per cent of the total port projects included in phase II of the Decade programme.

This HANDBOOK is general but lays down the basic principles of Mechanical cargo handling equipment maintenance problems. It calls also the attention of every port authority in Africa to appropriately provide adequate budget, trained staff, make regular supervision and follow-up and appropriate control including visits of workshops, plants, stores etc.

In order to know also what happens regarding maintenance of mechanical equipment or when a particular maintenance is to be completed, good communications between operations officer and maintenance engineer should exist. Some of the appropriate method of communication in this regard are suggested as follows:

- notify the operations department of work to be undertaken,
- schedules for all routine maintenance,
- work assignment to foreman or others,
- return of equipment to operation together with details of repair time, travelling time etc.,
- keeping plant history records,

Such information should enable the operations department to maintain record of all outstanding work, prepare performance indices for managerial control and financial purposes.

For information on requirements or performances of maintenance works in ports, Port Managements will be advised to prepare various information forms such as:

- work request (work order)
- job assignment
- work completion
- plant history record
- stores record
- spare parts order etc.

Preparation of forms can vary from port to port and Port Authorities should design their own information forms as per their requirements. However, they should be also careful not to have too much paper works rather than the maintenance work and for this they should limit them.
List of the main cargo handling equipment used in African ports

Broadly speaking there are four main categories by which Port Cargo handling equipment can be classified and they are:

(a) Bulk handling equipment
   (i) Unloader. There are mainly three types of Bulk cargo handling unloaders and they are:
      - Grab Bucket type
      - Pneumatic type
      - Bucket wheel type

Grab bucket type unloader

It has two types, namely bridge crane type and level luffing crane type.

Bridge crane type
- man-trolley type
- rope-trolley "
- grab trolley "

Level luffing crane type
- double link type
- swing lever "
- rope balance =
- tension rope "

Grab bucket type unloaders are usually used for mass unloading operations of large ships. Those unloaders over the capacity of 1000 t/h can be classified under this category.

Pneumatic type unloader

It is most suitable for unloading grains such as wheat, soya beans, powdery materials such as alumina, soda ash etc. Compared with the grab bucket type unloader, it is limited in its capacity between 400 - 500 t/h.

Bucket-wheel type unloader

It is good for continuous handling system especially for unloading sand carrier barges.

(ii) Loader
   Ship loader for bulk goods
   There are many types of ship loaders and their performances are decided by industrial and economic conditions such as capacity, type of goods, ships in use, conditions and locations of work etc. Today there are ship loaders of 16,000 - 20,000 t/hr capacity. Loaders of 6000-8000 t/hr capacity are usual in most ports.
Ship loader for barged goods

The popular types of these type of equipment are the clamp belt system and the Special Spiral Chute system. Both have loading capacity between 2000-3000 bags/hr.

(iii) Belt Conveyor, Stacker and reclaimer

Belt conveyor

It is a machine which can continuously transport parts, products, bulk cargoes such as coal, coke, ores, sand, grains etc. It can be classified as belt, chain, roller, screw, air, water etc.

Its capacity can extend up to 4000 t/hr with a belt width of up to 2000 m/m and belt speed of 300 m/min. for raw materials and more than 5000 t/hr capacity for sugar transportation.

Stackers

Stackers are specialized machines used for continuous stacking of bulk cargo in storage yards and are made of tripper and a stacking conveyor. Their handling capacity range from 100 to 1000t/hr.

Reclaimer

They are machines for continuous reclaiming and discharge the stored bulk cargoes from the storage yard.

Stacker - reclaimer

They have two functions of stacking and reclaiming in a single unit.

(b) Container and General Cargo Handling Equipment

(i) Containers handling

Containers which recently came in world-wide use can transport cargoes of various shapes and sizes by standardizing in a single form, and give quick handling and carrying operations, and contribute largely on the modernization of marine transportation.

There are two basic types of handling and storing containers and they are the lift on/lift off and the role on/role off types as to handling and as to storing the chassis and the direct ground types. There is also the LASH system.

Role on / Role off

In this system the use of cranes in loading and unloading containers takes place.
Lift on/lift off

Here the forklift trucks and/or the side loaders are employed in transferring, loading and unloading containers. The ship has the entrance on the side or at the stern and a ramp way is provided.

Lash system

It is the modification of the lift on / lift off system. The mother ship at unchorage, with its large crane unload barges to be towed to wharfs by tug-boats.

Standard type container cranes

- rope trolley or semi trolley type (a driver's cab is usually suspended on the trolley) with lifting capacity of 35 tons;
- container crane for container and other heavy cargo; this container is equipped with hooks or other accessories for heavy duty goods other than containers. The capacity is usually higher.
- twin lift container crane; A special spreader is provided for the purpose of handling 2 sets of 20ft container at the same time.

There are also grab trolley and shuttle girder type container cranes. All types of container cranes are either ship gantry or railway gantry cranes.

As for the transportation of containers in the terminal, a transfer crane and a straddle carrier (van carrier) are widely used. Both types have the capability of handling and conveying operations. The straddle carriers is used for stacking containers 2 or 3 heights.

(ii) General Cargo Equipment

The usual type of equipment for general cargo are:

Quay cranes

There are two-types - fixed quay cranes and portal quay cranes. They usually have 3-10 tons capacity.

Heavy derricks - They are heavy lifts stationed at quays or wharfs for loading and discharging. Lifting capacity for Heavy derricks are 15-25 tons.

In the family of this type of cranes other than mobile and floating, there are more than 10 types including quay and Heavy derrick cranes. They include crawler, railway, truck, overhead travelling, Hammerhead, travelling bridge, wall, Deck, Dock, transtainers cranes etc.
Tractors and Trailers

There are specially designed tractors or wheeled, fuel or electric driven and trailers used to transport cargo from ship's rail to transit sheds or vice versa.

Forklift: It is a self-propelled truck fitted in front with a plate form of two forks. The forks can be raised under its own power, from floor level to certain height. It is the most universal cargo handling machine in berth, apron, stores of a port.

There are forklifts for general cargo, container etc. handling and their size and lifting capacity differ considerably. Forklifts for containers are usually of 20-25 lifting capacity and that of the general cargo are 3-5 tons.

(c) Mobile and Floating cranes

Mobile crane: It is a running equipment erected (mounted) on rubber tyred wheels.

Floating crane is the same equipment mounted on a pontoon.

Both mobile and floating cranes are extensively used for handling cargoes in ports. They move freely without relying upon rails and perform cargo handling operation in ports just suitable anywhere.

The mobile crane is on the shore side and has lifting capacity from 3-20 tons. This machine can move for short distances with load in hanging according to its capacity. It can operate everywhere in port and outside port areas.

Floating cranes are also used to lift ship wrecks and other objects from the sea. They also give cargo operations services for vessels that work at anchorage. Floating crane can be divided into 2 kinds, namely, self-propelled and non-propelled. Capacities range up to 3000 tons. It can move freely over the water, and has a quite wide application in the handling of long-sized and heavy materials in ports.

(d) Auxiliary Machinery for Cargo Handling

Under this heading bulldozers, tractor shovel, log loaders, caterpiller, etc come. They have the functions of both handling and transporting of cargoes in ports and have come into wide use as the most general cargo handling machineries.

Bulldozers - Bulldozers are used in the handling of raw materials in ports and have proved to be effective machinery.

Tractor shovel - It has the greater utilization of mobility owing to the tyred wheel system. It is widely used for the handling of bulk cargo.

Log loader - Log loaders are used for the handling of logs in ports. The machine is used also for transportation of logs within port areas. Most of the log loaders in ports are rubber wheeled and their sizes vary.
Other miscellaneous port cargo handling equipment are simple grab, trays, slings, pallets, pontoons, lighters, rafts etc. which contribute much to port operations in African ports. Their role as well as their maintenance should not be neglected.

As it is usually the case the most important means of loading/unloading ships is by their own gear. This is because ships will be possible to load/unload in those ports where there are no quay cranes, independent of power failure on shore, provide means of loading/unloading cargo overside when ships not able to come alongside berths etc. Such ships gear include ships derricks, winches, Blocks, Runners etc.7/

7/ Cargo Handling Equipment Japan 1975
Operating Instructions to Operators of Cargo Handling Equipment

The following are basic measures to be undertaken by operators during the operations of Mobile and quay cranes and Forklift Trucks.

A. Mobile and similar cranes

1. Check tyre inflating - the correct inflation should be maintained;
2. Check acid level in storage batteries and connect all terminals to batteries; Distilled water should be added if necessary;
3. Check fuel level in fuel tank.
4. Check oil level of combustion engine,
5. During operation check ammeter which indicates charging, oil pressure which indicates pressure and temperature. Any failure should be investigated immediately and remedied as failure to do so could result in considerable damage.

B. Forklift Trucks and Tractors

1. Check general condition,
2. Check for underinflation of tyres, cuts etc.
3. Check battery and should be free from corrosin,
4. If hydraulics are free from leaks,
5. Check lights, meters etc. if they work or not and indicators are there;
6. The safety guard should be checked if fitted and has sufficient clearance for the operators,
7. Check lubrications and listen for irregular noises,
8. Check whether forks are raised to full lift for travel.

C. Cranes

1. Check for paintwork and corrosin,
2. Check completeness of guard doors, hand rails etc.
3. Check fitting and function of load indicators,
4. Check for lubrication and if greasing points have been used,
5. Check for hooks, spreaders etc. 8/.

8/ Port Maintenance World Bank September 1982
Part 2 - Back-up Material