

DEGRADATION OF WATERFRONT REINFORCED CONCRETE STRUCTURES AT THE PORT OF DAR ES SALAAM

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The paper summarises the results of an investigation done on piers at the Dar es Salaam Port. The problem facing these structures and marine facilities is their exposure to aggressive environmental phenomena. The paper presents an investigation of the strength and corrosion of concrete seaport piers so as to determine degradation of the reinforced concrete waterfront structures in the port of Dar es Salaam. For instance the structures at a dhow quay terminal had been in use for about 100 years. The facility was in bad condition as the concrete had been badly damaged due to corrosion. Some of the elements of the structures had very wide cracks and most of the concrete on piers and struts had in some places substantially spalled and peeled-off exposing reinforcements. Small to wide cracks of up to 20 mm were noted on concrete piers for all berths and some few piers were severely corroded.

Keywords: Concrete deterioration, reinforcement corrosion, concrete strength, degradation, water front structures

INTRODUCTION

Durability of waterfront structures such as piers, wharves and bulkheads and other marine facilities is a major concern. The problem facing these structures and marine facilities is their exposure to aggressive environmental phenomena. Degradation of marine waterfront structures is caused by three categories of forces namely natural environmental forces including waves, currents, winds, sunlight and in some areas earthquake; chemical environmental effects such as carbonation, sulphates, acids, salts and chlorine effects; and biological attack, which is mainly the activities of destructive marine organisms (Gaythwaite, 1990; Mpinzire, 1999; Rubaratuka and Mulungu, 1999).

The most common waterfront structures are reinforced concrete. The major problem with reinforced concrete structures is durability. The marine environment has a strong influence on the durability. Corrosion and scouring under the foundation, result in rapid deterioration and

instability of the concrete structures. Rapid deterioration of reinforced concrete is also caused by poor design, poor workmanship and the use of low quality material (Raka and Triwulan, 1992; Rubaratuka and Mulungu, 1999).

Carbonation is one of the major chemical factors that cause structure deterioration. It is a chemical reaction between atmospheric carbon dioxide and hydrated cement. It causes a reduction in the alkalinity of the concrete and destroys the passive oxide film around the steel after which corrosion happens thereby resulting in cracks to the concrete. However, carbonation has an advantage in non-reinforced concrete as it seems to densify concrete surface and hence makes the carbonated matrix stronger. It reduces chloride ion permeability, surface porosity and hence sorptivity in concrete (Rubaratuka and Mulungu, 1999; Ramezaniyanpour, et al, 2000; Arita, et, al., 2001; Chi, et, al., 2002; Concrete Experts International, 2002;)

Corrosion on concrete is a chemical process in which a concrete structure is attacked by seawater. Corrosion of steel reinforcement contributes greatly to the deterioration of reinforced concrete structures. Corrosion products accompany the formation of the rust and occupy a larger volume than the original metal in a magnitude of 2 to 3 times. The outcome of this expansion produces internal stresses sufficient to disrupt the surrounding concrete and therefore leads to cracking and disintegration of part of the surrounding concrete (Perkins, 1976; Mpinzire, 1999).

Corrosion on concrete normally occurs when elements of cement in concrete react with seawater to produce lime. The produced lime dissolves in water, leaving pores on concrete (Mpinzire, 1999; Raka and Triwulan, 1992).

In the construction industry, it is important to have a routine maintenance programme so that damaged and deteriorated structures can be repaired as they occur. Timely repair of structures is important to avoid the risk of structural failure due to the harsh marine environmental conditions to which they are exposed. However, the responsible authorities sometime neglect marine structures to the extent that they reach a stage where a major rehabilitation is needed (Gaythwaite, 1990).

In Tanzania, information on the integrity of seaport structures after a long service life in sea is lacking. Since marine structures are always subjected to high risks of corrosion, damage by incoming/outgoing ships and over loading, such processes/activities may lead to the collapse of these structures (Bertlin and Partners Consulting Engineers *et al.*, 1982; SLI Consultants, 1994; Swedport Consulting AB *et al.*, 1985). The interest of this study is to investigate the degradation of the existing reinforced concrete waterfront structures in the port of Dar es Salaam. The paper will concentrate on mainly carbonation and corrosion. The obtained information can be used by relevant authorities in their development plans and others.

THE STUDY AREA

The study area is the port of Dar es Salaam which is located along the shore of western Indian Ocean at latitude 6°50'S and longitude 39°18'E. The inner harbour is a tidal basin having a deepwater area of approximately 96 hectares with a narrow opening to the sea. The tides are semidiurnal with two high tides and two low tides daily. The harbour is well sheltered from strong winds and waves (Fig. 1).

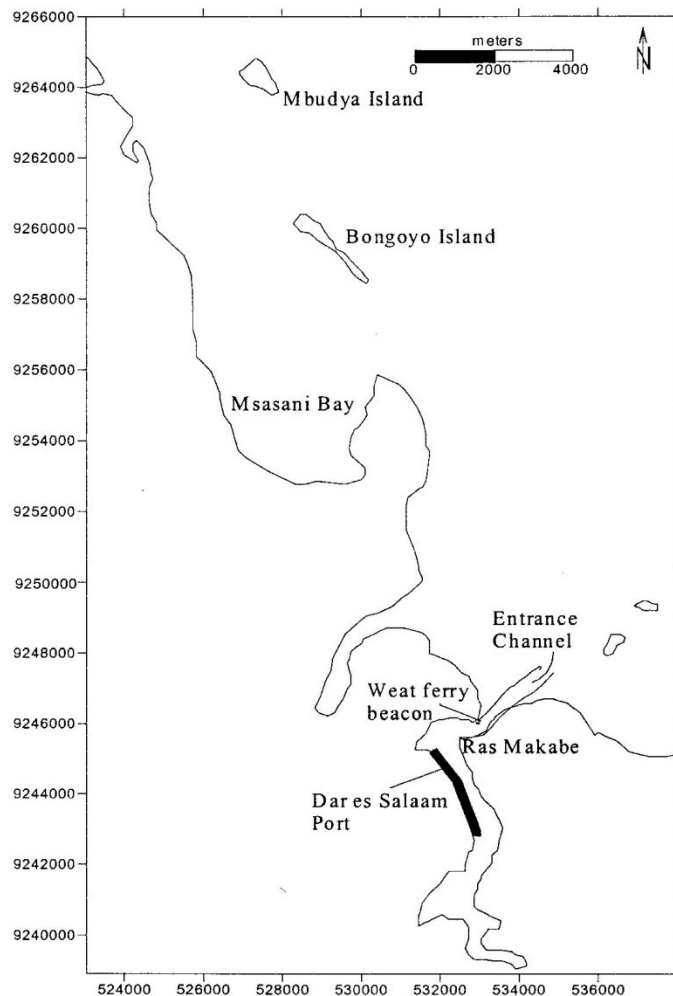


Figure. 1: Location of the Dar es Salaam Harbour

METHODOLOGY

Materials

In carrying out the study the following materials and equipment were used: A measuring tape,

camera, chisel, hammer, phenolphthalein, a boat and rebound hammer (Schmidtthammer).

Field work

A thorough check-up on physical condition of reinforced structures, material properties and the strength of the concrete after a long-term exposure to the sea and the effect of corrosion was carried out. The first activity was to check using visual observation the condition of existing structures including photographing the affected structures.

The second activity was to perform non-destructive tests with a rebound hammer on randomly selected points on piers, which appeared to be in a worse condition than the others. The calibrated "Schmidtthammer" test programme was used to provide a quick approximate compressive strength of concrete piers in different positions and on different points within the same pier. Structures were grouped into three categories according to their age and the area where the structures are found. The groups were as follows;

At lighter quay

- (a) Lighter wharf – dhow quay (Concrete pier built about 100 years ago during the Germany era)
- (b) Malindi cargo terminal (concrete pier)

At main quay

- (c) Berth 4 to 11 (concrete pier ageing between 25 and 35 years, constructed during independence era)

Rebound hammer was applied at the Malindi terminal where 15 points were taken on 5 piers for dhow quay and cargo terminal. At the main quay at berths 4 to 11 (concrete piers) 81 points were tested on 30 piers.

The third activity carried out was carbonation test using phenolphthalein indicator. Selected members with wide cracks were opened up using chisel and hammer in order to get inner concrete where phenolphthalein based straining agent was applied.

RESULTS

Visual observation

(a) The dhow quay at the Lighter wharf had concrete piers built during the Germany era. The structures at the terminal had been in use for about 100 years. The facility was in bad condition as the concrete had been badly damaged due to corrosion. Some of the elements of the structures had very wide cracks along the line of bars and most of the concrete on piers and struts had in some places substantially spalled and peeled-off in such away that the reinforcements were completely exposed (Plate 1).

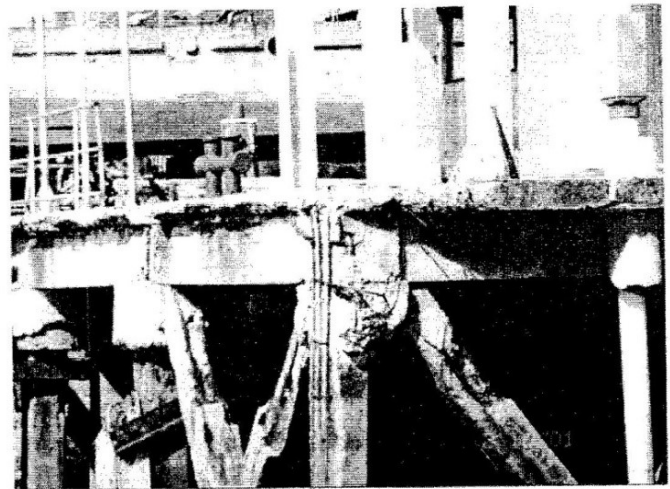


Plate 1: Concrete piers and struts severely corroded at Lighter quay .

(b) The concrete piers at the Malindi cargo terminal were in a very good condition. No signs of cracks and rusting were found on the structures. However, one of the piers had been damaged presumably by an accident because the fender system was in poor condition and therefore needed immediate rehabilitation.

(c) Berths 4 to 11 at the main quay had concrete piers. Small to wide cracks of up to 20 mm were noted on concrete piers for all berths and some few piers were severely corroded

especially on Berth 6 through Berth 8 (Plate 2). Structures at the terminal were in poor condition as corrosion of the reinforcement steel was very significant such that some few elements of the concrete structures had spalled and peeled-off too an extent that the steel reinforcements were exposed to the air (Plate 3). In such unrepaired condition, the piers are expected to lose a major part of their design load bearing capacity and structural strength. The concrete cover ranged between 20 mm and 30 mm.

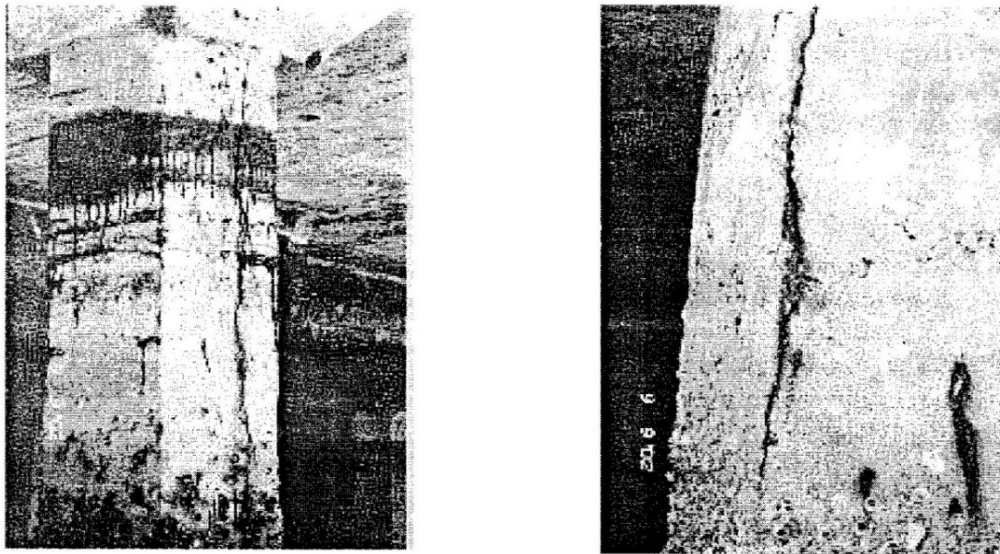


Plate 2: Typical cracks on concrete piers found on berth 4 through 8



Plate 3: Exposed reinforcement in one of the piers at main quay

Strength of Concrete

The maximum and minimum compressive strength for concrete piers as found according to rebound hammer at Lighter quay was 47.97 N/mm^2 and 24.01 N/mm^2 for Malindi cargo terminal and Malindi dhow quay respectively (Fig. 2). The mean compressive strength at Malindi cargo terminal was 39.13 N/mm^2 while at Malindi dhow quay was 32.13 N/mm^2 . At main quay the mean compressive strength was found to be 35.38 N/mm^2 (Fig. 2). Fig. 3 shows the comparison of compressive strength at different terminals. Concrete piers at Malindi cargo terminal have the highest strength with a maximum compressive strength of about 50 N/mm^2 . A minimum compressive strength of about 25 N/mm^2 was found at Malindi dhow quay.

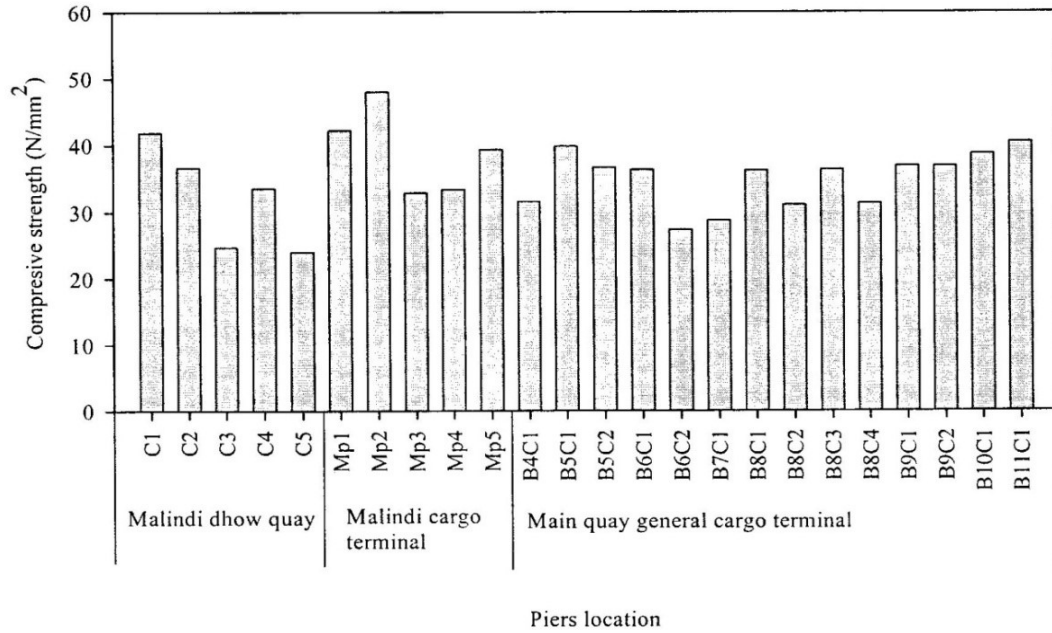


Fig. 2: Insitu compressive strength on concrete piers at the port of Dar es Salaam

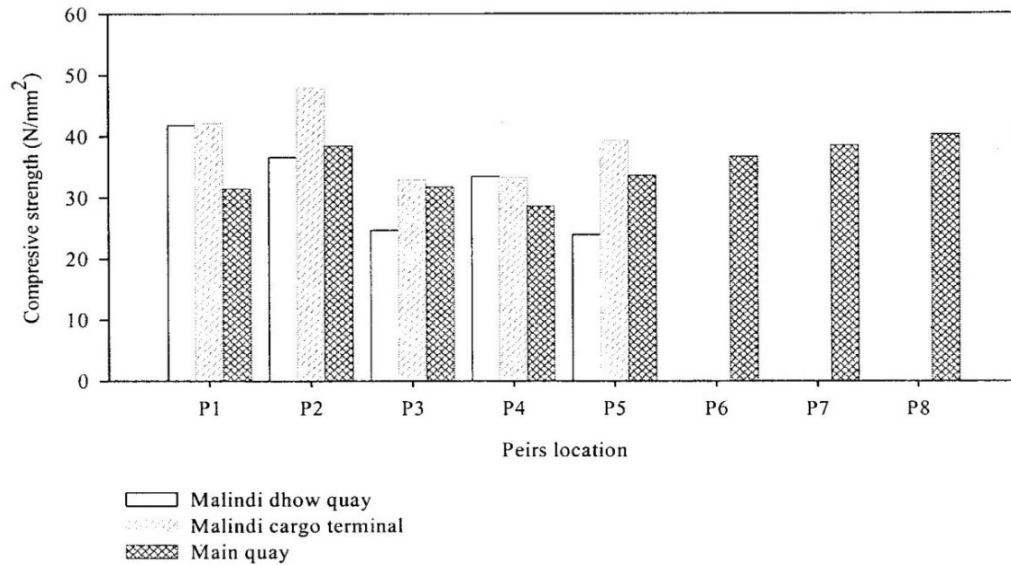


Fig. 3: Comparative insitu compressive strength for concrete piers as measured by rebound hammer at the port of Dar es Salaam

Carbonation

Carbonation test was performed as one of the standard tests used to check the life span of the concrete using phenolphthalein-based staining

agent on all selected piers and masonry walls. It is worth noting that the concrete had for very long time been subjected to harsh marine conditions. After application of the phenolphthalein indicator to concrete, there was

a change in colour profile to pink on both outer and inner concrete, the exhibited pink colour was an indication that the concrete matrix was uncarbonated. The test had shown that the concrete still had a very high content of calcium hydrate.

DISCUSSION

After obtaining field results it was not possible to compare with theoretical ones because the calculations and design information used in designing concrete structures at the port could not be found and therefore the actual water-cement ratios and cement contents of the concretes were not known. Nevertheless, according to the British Code of Practice, BS 8110, minimum concrete grade in seawater (very severe condition of exposure) is grade 40. The results obtained at Lighter – dhow quay showed that the concrete strength was 24.1 N/mm^2 which was well below the nominal concrete grade 40. The upper value of 42 N/mm^2 was slightly above the nominal concrete grade.

Results obtained at Malindi cargo terminal concrete piers showed that the strength ranged between 33 N/mm^2 and 48 N/mm^2 . Therefore the low value was slightly below the nominal concrete grade while the higher value was well above the nominal concrete grade. At the main quay (berth 4 to 11) most of the concrete piers had compressive strength which was lower than the nominal concrete grade 40, except for some very few cases that had slightly higher results than the nominal concrete grade 40 as they ranged between 28 N/mm^2 and 41 N/mm^2 . Therefore the rebound hammer results of relatively low values provided a preliminary indication of the poor structural integrity of the concrete structures.

Phenolphthalein-based staining agent applied on opened concrete surfaces of the piers showed a high content of calcium hydrate, which is an indication of non-carbonation of concrete even after a long period of being in a harsh marine environment. This could be due the fact that port structures especially piers are always subjected to high relative humidity of more than 90%. With that high humidity carbonation cannot take

place (Ramezaniyanpour et al, 2000; Chi et al, 2002; Concrete Experts International, 2002). This means there was still passive protection of steel reinforcements in the piers.

Concrete cover has a function to protect reinforcements from corrosion therefore it should be sufficiently thick. Usually there are several factors that do influence the thickness of the concrete cover such as grade of the concrete, conditions of the surrounding environment and fire resistance. The cover of 20 to 30 mm on the piers was well below the minimum permitted for concrete under very severe exposure. According to British Code of Practice BS 8110, the nominal cover to reinforcement for structures exposed to seawater (being a very severe condition of exposure) for concrete grade 40 is 50 mm. An early corrosion of reinforcements is inevitable due to shortened penetration path to the reinforcement of corrosion agents.

CONCLUSION AND RECOMMENDATION

The main conclusion is all concrete piers at the port were not affected by carbonation. This was true for even the structures which were built some 100 years ago. The deterioration of the structures noted at the port such as the spalling and peeling-off of concrete was due to corrosion of reinforcement caused by harsh marine environmental parameters while carbonation did not play any part in the deterioration of the investigated structures.

The results showed that the structural integrity of the observed quay support structures at the port of Dar es Salaam was questionable. The load bearing capacity of the supports is well below that considered during the design. The lighter-dhow quay support structures were in poorest condition compared to others.

It is recommended that investigations be carried out to determine the roles played by other agents besides carbonation in the deterioration of concrete under marine environment, as it has been proved that carbonation does not play any role in a marine environment.

tenants need to know their options in terms of house availability, rental rates and locations.

As ICT becomes crucial in our daily lives and particularly in business, this study was conceived, and its main objective was to establish the role which ICT could play in marketing residential real estate in Tanzania. In fulfilling this objective the study explored the available ICT functions and their use in the marketing of residential real estate. Emphasis was placed on the real estate agents and government institutions dealing with real estate in Tanzania. By adopting ICT in marketing residential real estate in Tanzania many benefits can be realized ranging from expanding business opportunities, to facilitating existing business processes, so as to maintain growth, and to keep up with the global competition.

LITERATURE REVIEW

The question of residential real estate in Tanzania is very much linked with the country's urban areas development. These are areas where residential real estate problem is critical and is in crisis. The demand outstrips the supply of the residential real estate stock by a big margin. Many writers and researchers have noted this fact. For instance, according to Makoba (2001), overcrowding levels that are found in urban areas confirm the growing residential real estate shortage. Likewise Kabyemera (2000), has noted this situation especially in Swahili houses in Dar es Salaam in which a single house accommodates six and more households, with a total of thirty or more people.

In stressing this problem Makoba (2001), further observed that:

"....on understanding that an occupancy rate of more than two people per room constitutes overcrowding, the percentage of families in overcrowded homes in Dar es Salaam city is 34.4 percent, Mwanza city 34 percent, Arusha and Moshi is 37.2 per cent".

In spite of these harsh realities, the urban population of most of the developing countries (Tanzania being one of them) will continue to

grow at a very high rate over the next 20 years (Renaud, 1994). Therefore this will mean an increased demand for housing.

Likewise Simba (1995), has also touched on the question of urban housing problems. According to him, inaccessibility to urban planned land by the housing developers and lack of funds are the major reasons for this problem.

Information and Communications Technology (ICT) advances since the end of the 20th Century have led to multiple convergences of content, computing, telecommunications and broadcasting. They have brought about changes in other areas, particularly in knowledge management and human resources development (Business Times, 2003).

According to Mkanachapa (1997), ICT are reshaping many industries. Information intensive industries, by their nature, show the greatest impacts due to ICT. Also, information intensive industry structures are most likely to be challenged by ICT which enable information sharing and the bypassing of traditional information intermediaries. Further, while ICT are often associated with organizations (and industries), their use occurs at the individual level. In other words, in such industries, changes to individual work due to the use of ICT reshape both organization and industry structures and vice versa.

Increasing capacity of ICT has further been empowered by growth of a global network of computer known as Internet. It has impacted the way business is conducted, facilitated learning and knowledge sharing, generated global information flows, empowered citizens and community in ways that have redefined governance, and have created significant wealth and economic growth resulting in a global information society (UNECA, 1999).

Real estate market simply means the arrangement by which buyers and sellers of virgin land, agricultural estate, industrial building, commercial and residential buildings are brought together to determine price at which the particular property can be exchanged (Harvey, 1992).

Residential real estate in Tanzania is an important sector in the economy as it is a big source of government revenue in the form of taxes to run the country's activities. It supports other economic businesses and a lot of other sectors depend on it for the provision of housing for residential and business activities. The financial sector is closely interlinked with the real estate sector to the extent that banks may collapse if real estate sector crashes (Kabyemera, 2002). However, in Tanzania, the sector is complex, cumbersome, paper-based and characterized with lack of transparency, and secretive information on transactions.

METHODOLOGY

The sample for the research was based on purposive selection of organizations and persons that are involved in real estate work in Dar es Salaam city. Questionnaires were designed in order to provide the study with the background information on each firm/individual that participated in the study and to get a clear picture of the level of ICT use of the population under the study. Respondents who participated in this study were employees of the real estate agents firms/government institutions, real estate owners, briefcase estate agents and tenants. In addition to the questionnaires interviews were conducted to the selected real estate actors.

Primary data collected included information on the kinds of services offered, the kind of ICT related services being used, and how information is passed to clients. Secondary data were also used in this study. This was collected from different reports, manuals, journals, websites and other documents concerning ICT and residential real estate marketing in general.

Data was analyzed using both qualitative and quantitative methods. Quantitative data analysis was done through the use of statistical measures. The type of data analysis done was of descriptive nature.

FINDINGS

A total of 50 questionnaires were distributed to various stakeholders of real estate sector in Dar es Salaam. Out of these 35 were collected, representing a 70% response rate.

Table 1 summarize the methods used to market residential real estates, where it is seen that over one-third of respondents use internet in marketing residential real estates. All respondents use letters, telephones and word of mouth, 11.4% use mass media, and 20% use various advertisements.

Table 1: Methods used to market residential real estate

	<i>Method of Communication</i>	<i>No of users</i>	<i>Percent</i>
1	Letters	35	100
2	Internet	12	34.3
3	Telephone	35	100
4	Word of Mouth	35	100
5	Advertisement	7	20
6	Promotion	0	0
7	Mass media	4	11.4

The results indicate that traditional modes of communication like letter and word of mouth are widely used compared to the modern means of using ICT.

Reasons for not Using ICT Extensively

In order to get a clear and broad based knowledge of ICT usage within the real estate industry, respondents were asked to state the reasons why they are not using ICT in marketing residential real estate.

Out of the 35 respondents 25.7% mentioned inability to access ICT tools to be the cause, and 20% lack of appropriate knowledge on ICT. However, lack of awareness of all its features and potential was evidenced by few of the respondents (11.4%), as summarized in Table 2.

Table 2: Reasons for not using ICT

Reason	No. of respondents	Percentage
Inaccessibility	9	25.7
Lack of knowledge	7	20
Unawareness	4	11.4
Others	15	42.9
<i>Total</i>	<i>35</i>	<i>100</i>

Other additional reasons mentioned include reluctance on the part of senior managers to give staff the opportunity not to be tied to the central office, anti-technology culture and an absence of appropriate education and training. These form 42.9% of the respondents.

Apart from the reasons observed above, the study also discovered that the major cause of not using ICT in marketing residential real estate was due to the fact that residential real estate markets' information is very little and unsystematic; this is due to the following reasons:

Informal Residential Real Estate Market Dealings

Accessibility of market data resulting from direct negotiation between buyers and sellers in informal settlements is usually limited. Witnesses who are usually ten cell leaders and "Mtaa leaders" witness in confidence with a promise of anonymity to the parties concerned. Hence strong moral obligations exist among those who witness the sales. None of these officials would wish to betray the confidence of their clients. Furthermore, Mtaa leaders and ten cell leaders are part time posts within the municipal set up and therefore holders of the posts are not in the municipal payroll, and therefore they rely on various fees paid in respect of services provided by their respective offices.

Limited Data Sharing

From the discussions with real estate agents it was apparent that real estate firms are not

sharing information amongst themselves. A number of issues were mentioned as being a hindrance to sharing of information. These include: confidentiality, excessive workload needed to collect and compile data, financial implications, sensitivity around competition on the estate agency assignments and trust, particularly on how their data is going to be used.

Confidentiality of Government Records

Government departments such as the Tanzania Revenue Authority (TRA) keep information inter alias, on properties that have changed hands and some form of taxation levied against them. Although this could have been a good source of market information, such records are not open to general public as is stipulated in section 18 of the Income Tax Act (1973), that "*...no individual estimates or returns and no information relating to an individual undertaking shall be disclosed.....*"

The Registrar of Titles offices in Dar es Salaam, Moshi, Mbeya, Dodoma and Mwanza keep records of all real estate transfer documents like deeds, wills and real estate contracts. But such records are also not available to the public.

Past valuation reports as a source of data presents another problem. The Government Circular No. 17 of 1974 insists on confidentiality of the valuation reports. A bonafide investigator may thus not have access to past valuation works. As a result basic information which could be analyzed, and enable a starting price of the subject property is made impossible.

Lack of Title (Deeds)

The process of land allocation and registration is fraught with bureaucratic delays and this has been identified as the major constraint to the development of vibrant housing markets information in Tanzania. This as a result hinders the use of ICT in marketing residential real estate. Moreover, most of the areas where residential real estates are constructed are not surveyed, and thus no title can be issued to them by the Ministry of Lands and Human Settlement

Development unless one does the survey him/herself.

Only 24% out of 25 respondents had titles as shown in Table 3. This has an impact on accessibility of information on that property, since the title (deeds) shows proof of legal occupation of the piece of land.

Table 3: People with/without title (deeds)

	Frequency	Percent	Cumulative Percent
Have titles	6	24	24
Have no titles	19	76	100
Total	25	100	

Use of ICT Related Services

Based on our examination of the descriptive statistics, ICT was divided into four groups 1) Computing technologies which are moderately used, 2) Telephone-related services which are heavily used, 3) Network services whose usage are low and 4) Internet which are moderately used.

Computer usage

Computer usage was measured by the number of tasks for which respondents use computers in their daily activities. seen that majority of the respondents use computers for word Tasks were

ranked according to the level of importance to the user. The results are shown in Table 4. It is processing, record keeping and accounting and bookkeeping. Training, E-Mail communication and Internet are rarely used.

Telephone-related services use

The study also sought to know how frequently the telephone related services are used in marketing residential real estate. The study found out that most of the estate agents use wireless and mobile phones frequently, in the course of communicating with their clients while fax machine are used occasionally. This indicates that even telephone related services are not fully utilized in the real estate industry as shown on Table 5.

Network services usage

The study went further beyond computerization level to network service use such as email, Internet, electronic data interchange etc. This was an attempt to assess the extent of ICT penetration and adoption by real estate firms.

The results (see Table 6) indicate that the estate agents use Internet services frequently, while E-mail communications within the company and with clients are occasionally used. However, the response shows that Electronic data interchange within the company and with the clients are never used. This indicates that a fair degree has been attained but still much need to be done to fully utilize the ICT in real estate industry.

Table 4: Computer Usage

Task	No. of respondents	Responses (in %)			Mean
		2	1	0	
Accounting and Bookkeeping	30	67	33	0	1.67
Word Processing	30	100	0	0	2
Record keeping	30	100	0	0	2
Training	25	0	27	73	0.27
E-Mail Communications	30	40	27	33	1.07
Internet Use	30	17	40	43	0.74

Scale: 0-1= Not important, 1.01-1.49= Somewhat Important, 1.5-2= Important

Table 5: Telephone-related services use

<i>Services</i>	<i>No. of respondents</i>	<i>Responses (in %)</i>			<i>Mean</i>
		2	1	0	
Answering machine	35	6	0	94	0.12
Voice mail	35	0	0	1	0
Wireless/Mobile phone	35	97	3	0	1.97
Fax machines	35	42	23	35	1.07

Scale: 0-1= Never, 1.01-1.49= Occasionally, 1.5-2= Frequently

Table 6: Network services use

<i>Task</i>	<i>No. of respondents</i>	<i>Responses (in %)</i>			<i>Mean</i>
		2	1	0	
E-mail communications within the company	18	39	33	28	1.11
E-mail communications with clients	18	49	38	13	1.36
Electronic data interchange within the company	18	0	0	100	0
Electronic data interchange with clients	18	0	0	100	0
Internet service	18	58	37	5	1.53

Scale: 0-1= Never, 1.01-1.49= Occasionally, 1.5-2= Frequently

Internet usage

The study went further to assess the extent of Internet usages in the course of marketing residential real estate as shown on Table 7. The study reveals that internet is highly used for sending email on personal and official purposes, obtaining general information about markets and

basic marketing through web page (providing basic information).

ICT Users' Attributes

Service industries are going through revolutionary changes. The companies in these areas need to have a global perspective. Here the employees require very good language and

Table 7: Internet use

<i>Tasks</i>	<i>No. of respondents</i>	<i>Responses (in %)</i>			<i>Mean</i>
		2	1	0	
Obtaining general information about your markets	18	67	28	5	1.62
Basic marketing through web page (providing basic information)	18	56	33	11	1.45
Marketing through an interactive web site	18	39	22	39	1
Communications and data transfer with other units of the company	18	33	39	28	1.05
Sending email on personal and official use	18	82	18	0	1.82

0-1=Not Important, 1.01-1.49= Somewhat Important, 1.5-2= Important

communication skills. ICT are also impacting the way content is delivered to clients. How we live up to the changes and challenges of a global economy and the skills levels, has been seen to have strong effects in general application of ICT facilities.

The study also explored on the ICT users attributes, that is their technical knowledge in ICT, and their overall attitude towards ICT (attitude toward change and computer related anxiety). The findings shows that the studied firms have been using ICT from two to five years back and the majority of the respondents have low knowledge in ICT, but they have a positive attitude towards ICT and that ICT can help to increase efficiency and effectiveness in marketing residential real estate.

It was observed that about 54% of respondents seem not to be competent in using ICT facilities, 34% of respondent were competent, and 12% have not come across such facilities at all. The competency of respondents is summarized in Table 8.

Table 8: Level of competency

<i>Levels</i>	<i>No. of respondents</i>	<i>Percent</i>
Competent	12	34
Not competent	19	54
Not applicable	4	12
<i>Total</i>	<i>35</i>	<i>100</i>

Generally, it was observed that, the use of ICT is relatively low in many real estate firms and is focused on fairly narrow range of ICT. Word processing is the predominant use made of ICT in real estate firms. It has also been observed that there is very little use of other ICT resources like Internet and World Wide Websites (WWW). However, despite the low levels on the use of this technology, its value in information provision is starting to be recognized by real estate stakeholders.

CONCLUSION AND RECOMMENDATIONS

Governments all over the world have tirelessly adapted ICT for service delivery to their citizens. The developing countries governments (Tanzania inclusive) are now overwhelmed due to ever increasing demand of ICT use as opposed to the limited budget the governments can afford to make, and due to global shift from industrial revolution to information communication technology, these governments are forced to comply with the changes.

However in real estate industry it was observed that these changes are gradually being brought up to real estate agents by the demands of more enlightened clients and the technological advancements. As the Internet spreads, people become more aware of its potential from a range of non-property applications and then demand the same level of service from the real estate industry. Advances in computer technology, near friction-less low cost of transmission of transactions, as well as the growth of the World Wide Web have placed pressures on the real estate industry as never before and challenge traditional assumptions about real estate transactions.

Technology has always been a driving force in community development. The three major global technological revolutions, the Agrarian Revolution, the Industrial Revolution and the Information Revolution, have, for example, led to growing societal formations ranging from the family unit, co-operatives, nation states, regional pacts and the global village. One of the most interesting characteristics of the information revolution is that it destroys boundaries.

Therefore, Tanzania cannot, and should not, try to escape the sweeping global changes, driven by the Information Revolution. In fact, we must harness these technological forces to effect our economic miracle. Nations that try to escape them are relegated to the ranks of the "Information Poor", "Poor" or "Underdeveloped" nations of the world.

It is finally recommended that real estate stakeholders need to join hands in developing a

database of real estate information using ICT. Training and raising awareness of ICT and its capabilities for various stakeholders in the industry is also recommended.

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