Big Data in Land Records Management in Kenya: A Fit and Viability Analysis

Tom Kwanya(✉)

Information Studies Programme, University of KwaZulu-Natal, Pietermaritzburg, South Africa
tkwanya@yahoo.com

Abstract. Big data is data whose size is beyond the ability of commonly used software tools to capture, manage, and process within tolerable time. The concept of big data has been necessitated by the growing capacity of the available information systems to facilitate the capture, processing, storage and use of large volumes of variable but credible data fast enough to generate optimum value for the users.

Land records in Kenya have been over the years managed through paper-based systems which are vulnerable to loss, wear and tear, compromise and poor usability. Consequently, land administration processes became inefficient, time consuming, unreliable, costly and ineffective. To address these challenges, the Government of Kenya in 2007 resolved to automate all land records and transactions by developing and deploying a land information management system founded on big data technology which is capable of holding vast and diverse data sets on land ownership and transactions. The decision to automate land records and transactions was in compliance with the provisions of the country's National Land Policy launched in 2009. This study assessed how well the technology used by the new electronic system fits the needs and contexts of the users of land records in Kenya.

The study was conducted as an exploratory research based on the fit-viability theory. Data for the study was collected using interviews with 48 users of the new land information management system. The findings revealed that big data has a high fit and viability for the performance of land records and transactions management in Kenya. In spite of the high fit and viability, it was noted that the viability of the system is hampered by inadequate infrastructure, skills, organisational culture and organisational structure. Addressing these challenges through essential infrastructure development, institutional strengthening and capacity building will enhance the viability of the land records management system. The findings of this study may be used by policy makers in other developing countries to model big data projects. The findings may also be used by the managers of big data projects to enhance their fit and viability so as to yield optimum impact for their stakeholders.

Keywords: Big data · Kenya · Land records · National land management information system · NLMIS · Apophenia

L. Uden et al. (Eds.): KMO 2014, LNBIP 185, pp. 15–24, 2014.
DOI: 10.1007/978-3-319-08618-7_2,

1 Introduction

Land ownership and use is a sensitive issue in Kenya and has been at the core of several conflicts in the country's history [8, 10]. Indeed, the agitation for Kenya's independence was catalysed by a direct resentment of the displacement of the natives by the British colonialists from the most arable farmlands, which became known as the White Highlands, to the less productive reserves where they could not grow the lucrative cash crops. The independence of the country created high expectations for the restoration of the land alienated by the British back to the natives. This, however, was not to be as the new native political elite and their friends amassed the available land leaving the majority of the ordinary citizens, including the freedom fighters, virtually landless [10]. To date, a few influential people own vast tracts of land while the majority are reduced to squatters, some in their own ancestral land, unable to enjoy the socioeconomic benefits of land ownership in a country whose economic backbone is agriculture. The scarcity of land triggered a vicious cycle of relentless struggles for land which has led to many conflicts and loss of lives and property in many parts of the country. Similarly, the pressure on land has led to the encroachment of water catchment areas exacerbating the effects of climate change.

Several attempts to deal with the land problem have been made by the Government of Kenya and other stakeholders. Some of these have included land legislation, demarcation, rationalisation and issuance of land titles. However, these attempts have not yielded any meaningful solution to the deeply rooted problems. So the land question persists and gets complex by the day. Therefore land remains an emotive issue which pops up in almost all civic and economic processes in the country [8]. This is understandable because land is an important factor of production in Kenya's agro-based economy. Lack of land practically cripples households or individuals economically. Consequently, many Kenyans work to own land by all means possible. These inevitably include criminal activities most of which revolve around the falsification or unauthorised modification of land records and transactions. To address this challenge, the Government of Kenya in 2007 resolved to automate all land records and transactions by developing and deploying a National Land Management Information System (NLMIS). The NLMIS is a big data system capable of holding and supporting vast and diverse data sets on land ownership and transactions.

2 What is Big Data?

Several definitions of big data exist. However, the term generally refers to data whose size and complexity force the users to look beyond the ordinary data management methods and tools [2]. These are data sets whose size is beyond the ability of commonly used software tools to capture, manage, and process within tolerable time [7]. Laney [3] defines big data in terms of "3Vs" which represent velocity, volume and variety. In this perspective, big data is vast, fast and diverse. A fourth "V", veracity, has lately been added to emphasise the significance of integrity in big data systems. Big data exists in varying sizes and forms including text, images, maps, videos, music and multimedia files. It is easier to get data in than out of big data systems due to

immense challenges relating to data capture, curation, storage, search, sharing, transfer, analysis and visualisation. Therefore, big data systems require high performance; speed of processing and retrieval; capacity to search, aggregate and cross-reference large data sets [1].

The perception of big data is time bound. Consequently, what used to be considered as big data as recently as in the 1980s is not necessarily considered in the same way today. The situation has been compounded by the rapid growth in data facilitated by the advancement in modern computing technology which has enabled a wider range of people to produce, share, interact with and organise data. Similarly the emerging technology has exposed the hitherto obscure data to all cadres of professional and lay persons [1]. The definition of big data may also vary from one organisation to another depending on the available technical, structural and infrastructural capacity to manage the data the organisation generates, transmits or receives.

Boyd and Crawford [1] argue that big data should be perceived as a cultural, technological and scholarly phenomenon anchored on the interplay of technology, analysis and mythology. This implies using technology to maximise computation power and algorithmic accuracy to gather, analyse, link and compare large data sets to identify patterns in order to make economic, social, technical and legal claims. They explain further that there appears to be a widespread mythology that large data sets offer a higher form of intelligence and knowledge that can generate insights that were previously impossible, with the aura of truth, objectivity and accuracy.

It is also important to point out that big data does not only refer to large sets of data stored in complex devices but also the skills and tools with which they are manipulated. Big data systems offer enormous capacity to collect and analyse data with unprecedented depth, breadth and scale [4]. Manovich [7] categorises big data users as (1) those who create big data; (2) those with the means to collect it; and (3) those with the expertise to analyse it. Regardless of the big data user category, it is noteworthy that limited access to big data creates new forms of digital divides through uneven access, skills, levels of contribution and economic power which ecosystems which are "big data rich" facilitate better than those which are "big data poor".

Boyd and Crawford [1] question the objectivity of data sets held in big data systems. They explain that the users of big data systems may suffer from apophenia which they describe as seeing nonexistent patterns due to the existence of enormous quantities of data creating connections which radiate in all directions.

3 Problem Statement

For many years, Kenya's Ministry of Land, Housing and Urban Development, which has the overall responsibility over land administration, has relied on paper-based records to discharge its duties. Over time, paper records in the ministry grew in size and complexity making them generally inaccessible and unusable. Consequently, land administration processes managed by the ministry increasingly became inefficient, time consuming, unreliable, costly and ineffective. The NLMIS was conceived to address these challenges by establishing a land administration system which enables the creation of accurate, accessible, interoperable, timely, secure and complete

information about land in an affordable and efficient way. The NLMIS is aimed to facilitate improved land resource management, reduce land disputes, stimulate land markets, improve service delivery, improve spatial land use and improve environmental stewardship in Kenya.

The NLMIS project was launched in 2008 to provide a platform for the effective land management and administration services which comply with the letter and spirit of the Kenya Vision 2030, new Constitution promulgated in 2010 as well as the National Land Policy approved in 2009. Specifically, the National Land Policy requires that all land information be computerised and made widely available in a language most citizens can understand and at an affordable price; existing paper land records be reorganised, updated and authenticated in readiness for their computerisation; standards to be developed to guide the generation and dissemination of land information, the training of relevant professionals and awareness creation among citizens; land surveys, including the re-establishment of the framework of accurate survey points (control points), to be carried out more efficiently and accurately using modern technology; Kenya's land information management system to be in harmony with those of other countries in the region in order to facilitate regional exchange of land information and execution of regional projects; and a law to be enacted to provide for all aspects of land information access and management, including the protection of intellectual property rights.

The development of the NLMIS included the digitisation of all paper land records held by the ministry both at its headquarters and also in its field offices countrywide. The NLMIS was designed to be supported by a robust infrastructure linking the various producers and users of land records. The system was also to boost transparency and accountability of land transactions and enhance the integrity of land records.

Although anecdotal evidence indicates that the project has been implemented fairly well, no scientific evidence exists to demonstrate the system's suitability and relevance in mitigating the challenges hampering the effective management and use of lands record and transactions in Kenya. This study assessed how well the big data technology applied by the NLMIS fits the tasks associated with land administration and transactions in Kenya. It also analysed the extent to which the environment in which the NLMIS is implemented is facilitative of its operations.

4 Theoretical Framework

The researcher used the fit-viability theory to assess the suitability of the NLMIS as a big data system to manage land records in Kenya. The theory was originally proposed by Tjan [9] as a model for evaluating the adoption of the Internet by organisations. Liang *et al.* [5] explain that fit measures the extent to which new technology tools are consistent with the core competence, structure, value and culture of the adopting organisation. On the other hand, Liang and Wei [6] explain that viability measures the extent to which an organisation's environment is ready for the new technology tools and applications. The environmental factors include economic costs and benefits, users' readiness to apply the technology and the maturity of the organisational structure to support the technology.

In the present study fit measured the extent to which the salient features of big data such as volume, velocity, variety, and veracity suit the essential tasks associated with land records management at the Ministry of Land, Housing and Urban Development in Kenya. The researcher also proposed another "V" representing the financial or sentimental value attached to land records and transactions in Kenya. On the other hand, viability measured the factors which influenced the success with which big data systems such as the NLMIS are implemented. These included economic, social, technical, infrastructural, quality and other human factors. The performance of the NLMIS is facilitated by a high technological fit and organisational viability leading to a high performance exemplified by the usability of the system and user information satisfaction. Figure 1 below summarises the application of this theoretical framework.

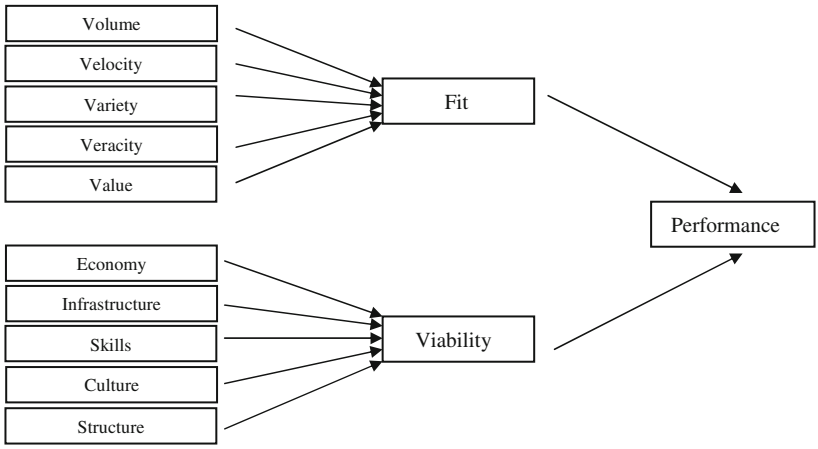

Fig. 1. The NLMIS fit-viability conceptual framework

5 Methodology

The study used an exploratory research design because big data is an emerging concept, especially in developing countries such as Kenya. Data was collected through face-to-face interviews with two sets of respondents. The first set was 25 staff of the Ministry working with the NLMIS to offer various services to the public. The second set comprised of 23 users of the NLMIS. 33 of the respondents were male while 15 were female. Similarly, 7 were under 30 years old, 12 were aged between 30 and 40 years, 19 were aged between 41 and 50 years while 10 were above 50 years old. The majority (25) had high school education; 15 had college education while eight had primary school education. A simple structured questionnaire consisting of lickert scale questions was used to capture the feelings of the respondents about the various fit and viability elements of the NLMIS identified above. The questions generally probed the respondents' perception of the fit and viability variables outlined above. The responses were given scores based on how they agreed or disagreed with a statement on a variable. Strongly disagree scored 1 while strongly agree scored 5. Thus, a high score

represented a high fit or viability. An average of the fit and viability scores represented the overall performance of the NLMIS. The questionnaire was administered in Nairobi.

6 Findings and Discussions

The key findings of the study are presented and discussed hereunder.

6.1 Fit

The average of the scores on the different fit variables was 4.14 out of a possible 5. This implies that the NLMIS has a high fit for the needs of the users of land records in Kenya. Further details of the findings associated with the fit are provided hereunder.

6.1.1 Volume

The majority of the respondents (67 %) strongly agreed (score of 5) while 17 % of the respondents agreed (score of 4) that the system enabled them to access and transact on high volumes of records. This indicates that 84 % of the respondents were happy that the capacity of the NLMIS to accommodate large volumes of records fits closely with their need. The remaining 16 % said that the system was average (score of 3) in enabling them to access and use huge volumes of records. It is evident from the findings that the majority of the users of the land management information system in Kenya are of the view that the capacity of the system to support transactions on huge volumes of records fits well with their needs. This view is most likely informed by the fact that the NLMS consists of several high capacity servers which have large information storage ability enabling the users to store and access maps and other land transaction records with ease. The system also makes use of cloud computing to enhance its capacity to support near-infinite transactions on vast amounts of data at the ministry's headquarters and field offices countrywide.

6.1.2 Velocity

Most of the respondents (83 %) agreed (score of 4) that the system has accelerated the speed of access and use of land records. On the other hand, 17 % of the respondents strongly agreed (score of 5) that the system supports fast access and use of land records. This implies that all the respondents generally agreed that the new system has accelerated the speed of access and use of the records. They explained that the physical land records management system used earlier was slow making land transactions to unnecessarily drag for long periods before conclusion. They explained further that such delays were costly and sometimes led to serious mistakes or crimes being committed in the course of the transactions. They expressed the hope that the new system will reduce, if not eliminate, such mistakes as well as the financial and other costs associated with them. They also said that the capacity of the NLMIS to facilitate fast access and use of land records will enhance the transparency of land transactions thus eliminating the bottlenecks which encourage or cover up corruption.

6.1.3 Variety

About half (51 %) of the respondents were neutral (score of 3) about the capacity of the system to enable the department to manage a wide variety of land records. However, 35 % of the respondents strongly agreed (score of 5) that the NLMIS supports diverse forms of records and access methods. 14 % of the respondents agreed (score of 4) that the system supports variability. The high number of respondents who are neutral on the variety feature of the system perhaps emanates from the fact that the system is not fully implemented. Some features supporting variety may not be fully operational yet. One of the biggest challenges hampering the full implementation of the system feature which support variety is the vast amount of paper records to be digitised which has overwhelmed the ministry staff. Similarly, the system currently focuses on the management of information generated by digitising the paper records. Other sources or types of data such as email, short messaging service or multimedia files are currently not fully supported. It is probable that the perception of the respondents of the variety of the NLMIS records may change when the system is fully operationalised.

6.1.4 Veracity

Nearly half (49 %) of the respondents strongly agreed (score of 5) while 37 % agreed (score of 4) that the new system has enhanced the access and use of accurate land records in Kenya. 14 % of the respondents were neutral (score of 3) about the veracity of the new records system. These findings imply that most of the users of the new information system are convinced that it facilitates the access and use of accurate records while a minority seems to hold a "wait and see" view. One issue which may have affected the accuracy of the records is that the digital system is based on the earlier paper one which had lots of inaccuracies. Therefore, it will require some time before all the records are validated and corrected to enhance their veracity. Big data enhances veracity by enhancing security of records to reduce their manipulation. Big data also provides the techniques and tools for cleaning confirming the validity of records before being integrated in the NLMIS. Big data also makes it easy to detect and correct errors.

6.1.5 Value

The majority (37 %) of the respondents strongly agreed (score of 5) while 33 % of the respondents agreed (score of 4) that the system has enabled the users to conduct high value transactions. 30 % of the respondents remained neutral about the value levels of the transactions facilitated by the NLMIS. The findings indicate that 70 % of the respondents are convinced that the NLMIS facilitates high value transactions. This indicates that the users are getting value for the resources – time, effort and money – they invest in using the system. This view may have also been influenced by the fact that the NLMIS saves the time and costs associated with accessing and using land records. This not only generates financial but also enhances the sentimental value of the system. The 30 % of the respondents who seem not to hold any strong views about the value of the transactions are perhaps buying time to get adequate information or

experience on which to anchor their assessment of the system. It is probable that their views may change as the system gets used widely.

6.2 Viability

The average viability score of the NLMIS is 3.68 out of a possible. This implies that the respondents perceive the system as viable. The section below presents more details of the findings relating to the viability of the NLMIS.

6.2.1 Economy

The majority (53 %) of the respondents strongly agreed (score of 5) while 35 % of them agreed (score of 4) that the system has facilitated cost-effective access and use of land records. 12 % held neutral (score of 3) views on the economic benefits of the system. The pessimistic views may be influenced by the fact that some records are still missing from the system or filed inaccurately; persisting red tape and bureaucracies involved in locating, accessing and using missing or misfiled records; resistance to change by staff and users of the system; and the relatively high costs of acquiring technological tools to manage or use the records. These views may change as the NLMIS processes get streamlined. All the respondents were unanimous that the economic environment – exemplified by the demand and supply of land transactions – in Kenya is suitable for the NLMIS.

6.2.2 Infrastructure

Most of the respondents (39 %) disagreed (score of 2) and 17 strongly disagreed (score of 1) that the infrastructure available at the ministry adequately supports the effective use of the NLMIS while 26 % (score of 3) were neutral on the issue. 8 % of the respondents agreed (score of 4) that the existing infrastructure adequately supports the NLMIS. The findings imply that more than half of the respondents are not confident of the adequacy of the existing infrastructure. This view may be influenced by the lack of computers and ample bandwidth to support the effective operation and use of the NLMIS. This finding is in tandem with the prevailing status of the information infrastructure in the country. Several information and communication technology projects are ongoing. It is expected that, on completion, these projects will improve the infrastructural viability of the NLMIS.

6.2.3 Skills

The majority (52 %) of the respondents agreed (score of 4), 22 % disagreed (score of 2) while 8 % strongly agreed (score of 5) that the users of the NLMIS have the essential skills to enable them to make the best use of the system. 18 % of the respondents remained neutral (score of 3) about the skill levels of the current users of the NLMIS. The findings imply that 60 % of the respondents generally hold the view that the users of the NLMIS have the essential skills to use the system effectively. This is discordant with the general trends of ICT skills in the public sector in Kenya and other developing countries. The discordance may have arisen from the fact that both the users and staff responded by assessing their own competence to use the system. The results may have been different if each category was asked to assess each other.

6.2.4 Culture

The majority (43 %) of the respondents disagreed (score of 2), 20 % strongly disagreed (score of 1) while 9 % agreed (score of 4) that the Ministry of Land, Housing and Urban Development has an organisational culture which supports the effective use of the land system. 28 % remained neutral. The findings indicate that 63 % of the respondents were of the view that the ministry has an organisational culture which does not support the effective use of the NLMIS. These findings are in tandem with the general perception of the organisational culture in most public institutions in Kenya. This situation may have been created by a lack of commitment of staff to duty; frequent staff changes in the concerned department; lack of political goodwill to streamline operations in the public service; and the desire by staff to keep the status quo so as to benefit unethically from its inefficiencies.

6.2.5 Structure

Most (58 %) of the respondents were neutral (score of 3) about the appropriateness of the staffing and other structures in facilitating the effective use of the land information system. 27 % agreed (score of 4), 8 strongly agreed (score of 5) while 7 % disagreed (score of 2) that the current structure of the ministry supports the effective use of the NLMIS. These findings generally imply that the respondents hold the view that the current structure of the ministry makes the NLMIS viable. This view is also discordant with the general public perception that most government institutions in Kenya are too rigid and hierarchical to support techno-based and distributed information systems such as the NLMIS.

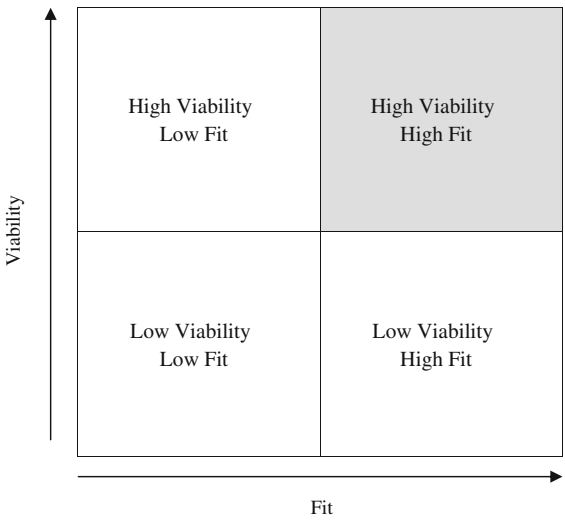

Fig. 2. The fit-viability analysis of the NLMIS

7 Conclusion

Overall, the respondents were of the view that the system has a high fit for the performance needs of the Ministry of Land, Housing and Urban Development in land administration. Most of the respondents were also of the view that the NLMIS is viable. However, the viability of the system is hampered by inadequate infrastructure, skills, organizational culture and organizational structure. These findings indicate that big data systems have great potential for application in various sectors in the developing countries. They also indicate that whereas there may be some challenges to the viability of big data projects in developing countries their likely fit is high. The performance of such big data systems may be enhanced by addressing the challenges compromising their viability. The viability of the NLMIS can be enhanced by improving ICT infrastructure, training of staff and users of the system, streamlining land management processes, introducing performance contracts for staff working in the lands department, and restructuring the department so as to reduce bureaucracies. Figure 2 below summarises the assessment. The overall assessment of the NLMIS falls in the coloured quadrant: high fit, high viability.

References

1. Boyd, D., Crawford, K.: Critical questions for big data: provocations of a cultural, technological and scholarly phenomenon. Inf. Commun. Soc. **15**(5), 662–679 (2012)
2. Jacobs, A.: The pathologies of big data. Commun. ACM **52**(8), 36–44 (2009)
3. Laney, D.: 3D data management. (2001). http://blogs.gartner.com/doug-laney/files/2012/01/ad949-3D-Data-Management-Controlling-Data-Volume-Velocity-and-Variety.pdf. Accessed 26 January 2014
4. Lazer, D., Pentland, A., Adamic, L., Aral, S., Barabási, A., Brewer, D., Christakis, N., Contractor, N., Fowler, J., Gutmann, M., Jebara, T., King, G., Macy, M., Roy, D., Van Alstyne, M.: Computational social science. Science **323**(5915), 721–723 (2009)
5. Liang, T.P., Huang, C.W., Yes, Y.H., Lin, B.: Adoption of mobile technology in business: a fit-viability model. Ind. Manage. Data Syst. **107**(8), 1154–1169 (2007)
6. Liang, T.P., Wei, C.P.: Introduction to the special issue: a framework for mobile commerce applications. Int. J. Electron. Commer. **8**(3), 7–17 (2004)
7. Manovich, L.: Trending: the promises and the challenges of big social data. In: Gold, M.K. (ed.) Debates in the Digital Humanities. The University of Minnesota Press, Minneapolis (2011). http://www.manovich.net/DOCS/Manovich_trending_paper.pdf. Accessed 26 January 2014
8. Njuguna, H.K., Baya, M.M.: Land reforms in Kenya: an Institute of Surveyors of Kenya (ISK) initiative (2004). https://www.fig.net/pub/proceedings/korea/full-papers/pdf/session7/njuguna-baya.pdf. Accessed 25 April 2014
9. Tjan, A.K.: Finally, a way to put your internet portfolio in order. Harvard Bus. Rev. **79**(2), 76–85 (2001)
10. Wanyumba, G.: A review of special land tenure issues in Kenya (2004). www.Fig.net/commission7/nairobi_2004/papers/ts_06_3_wayumba.pdf. Acessed 25 April 2014