

Investigating Software Development Methodologies and Practices in Software Industry in Tanzania

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Abstract: The last few years have seen a growing development of software industry in East Africa and Tanzania in particular. The software industry contributes up to 40% of economic growth in the past 10 years with the number of registered firms increasing yearly. Despite these developments, few studies have investigated the software development methodologies and practices that has been applied in the software industry and how they affect the success or failure of the software projects. This study investigated software development activities in 18 firms to determine to what extent the software development methods are being adopted and the factors influencing the selection of such methodologies. The study used questionnaire, semi-structured interviews, and documentary review involving 54 developers and project managers from 18 different software firms in Dar es Salaam, Tanzania. The study found that the majority of software firms have been adopting traditional software development methodologies accounting to 72% of 79 studied software products. Specifically, amongst 51 software products developed using traditional software methodology, nearly half of the software products adopted waterfall model. Moreover, agile methodologies and other iterative methods are rarely adopted in the software industry. The implications of result and recommendations are discussed.

Keywords: Software development, software industry, software development methodologies

1. Introduction

The last two decades have seen a growing development of software industry in East Africa and Tanzania in particular. The software industry has contributed up to 40% of economic growth in the past 10 years [1] while the number of registered software development firms has been increasing every year. In Tanzania, for instance, nearly 19% of 319 registered firms in 2015 were software development companies which was an increase of 61% from 2009 [2]. Although the software industry is still emerging, it can deliver approximately 0.1% to 1.4% of Gross Domestic Product (GDP) [3]. Therefore, this industry has been contributing to structural transformation, learning and innovation, job creation, and revenues generation [4]. Applications such as mobile money, for instance, have become the largest provider of financial services surpassing banks, with 35% of households owning at least one mobile money account [9], [10].

The increased number of software firms is driven by a number of factors. One being the increased number of ICT related university graduates who establish software firms as a quick way of self-employment. These graduates tend to develop software solutions that meet the

demand of Tanzania market and beyond. Moreover, several innovation hubs have been supporting ICT innovation and software development. The Tanzania Commission for Science and Technology (COSTECH) has embarked on supporting ICT innovation through Dar Teknohama Business Incubator (DTBi) where several software firms were established. These firms developed software products such as Tigo Twende App, Vodacom M-paper, and Tigo Backup [5]. Other established innovation hubs include Buni Hub, Kinu, and RLabs Iringa [6].

Developing quality software product within cost and time schedule that fulfils customer requirements is a challenge for today's software professionals and calls for a systematic approach to software development [12]. It is usually done using different development methodology, each with its own strengths and weaknesses and applicable for specific project with unique requirements [13]–[15]. For instance, some software projects require only good GUI, some require more security, and some software are made for mission critical tasks. Therefore, choosing one of methodologies for a specific project is not an easy task [16] and the chosen methodology has impact on the success or failure of the software to be developed [17]–[19]. This is to say, the success rate of software development projects can be increased by using methodologies that are adequate for specific characteristics of those projects [16], [20].

Despite the increased software development activities in East Africa and Tanzania in particular, few studies have investigated the software development methodologies and practices that has been applied in the software industry and how they affect the success or failure of the software projects. Therefore, the current study aimed to:

- Survey different types of software development methodologies and practices used in software industries in Tanzania.
- Investigate factors influencing developers in selecting software methodologies during software development.
- Investigate challenges facing software developers in the software industry in Tanzania.

The study adopted used questionnaire, semi-structured interviews, and documentary review involving developers and project managers from 18 different software firms in Dar es Salaam, Tanzania. The findings of this study will help universities to understand the gap existing in the software development methodologies they are teaching and the ones that are applicable in the software industry.

2. Literature Review

Software development is usually done using different methodologies which provide guidelines and procedures from the beginning of the software project to the completion of the product [21]. There are two categories of software development methodologies: the traditional methodologies, and agile methodologies [22]. The traditional methodologies are plan driven in which work begins with the elicitation and documentation of a complete set of requirements followed by architectural and high-level design development and inspection [16]. The stages vary according to the development approach being used but typically would include the following activities (i) feasibility study (ii) requirements engineering (iii) design of the system (iv) software development (v) software testing [23]. Some practitioners have found that the traditional methodologies pose difficulties as they restrict to backtrack to the previous phases which makes it difficult to make corrections [24]. Moreover, the use of these methodologies have been facing difficulties in keeping up with rapidly changing requirements of the software products during the development process [25].

In addressing these challenges, the agile methodologies such as Extreme Programming, Crystal methods, Lean Development, Scrum, Adaptive Software Development (ASD) have been adopted. Agile methods aim at reducing the software process overheads (like documentation) and concentrate more on code rather than the design [26] while releasing a working software early and continuously improving it with customers. Using working software allows developers to measure how fast they actually produce results and provides quick feedback [26], [27]. Despite the strengths of agile methods, some limitations do exist. Studies have pointed out that some limitations of agile methods include lack of defining a deliverable, lack of structure and necessary documentation, incorporates insufficient software design, and requires meetings at frequent intervals at enormous expense to customers [28].

It is clear that both agile methodologies and traditional methodologies have their own strengths and weaknesses (Balaji, 2012; Tanner et al, 2014). As a result, a number of studies have been conducted to investigate how the application of various methodologies had an impact on the success of the software project.

El-Deeb (2012) reviewed current practices of software engineering in Egypt using a sample of 60 major software companies. The study found that the majority of software firms lacked the needed establishment of a disciplined software process institutionalization. Moreover, many firms were found to use traditional development methodologies. Similarly, Safwan, Thavarajah, Vijayarajah, Senduran, and Manawadu (2013) found that the majority of software developers were using traditional software methodologies in a study conducted in software practitioners in Sri Lanka. The low usage of agile methods was due to the fact that that developers found difficulty to get everyone in the team to take responsibilities due too much cultural change during development process.

Iyawa et al. (2016) investigated the differences in customer interaction between software methodologies deployed in Namibian software firms using a sample of 10 project managers from three software firms. The findings showed that there is mixture of agile and traditional software methodologies applied in the development of software products. However, waterfall model was the most preferred methodology. The study also revealed that the software development cost was higher when the traditional software methodologies were used compared to the agile methodologies.

Alamdy and Osman (2017) investigated software development practices and risks associated with it in software industry involving 15 managers from companies in Sudan. The study found that more than half of respondents indicated that they were using agile (57%), few waterfall (24%) and a small number of respondents were using hybrid methodologies (19%). Moreover, insufficient description of software development procedures, communication methods and customer relations within companies were the key challenges facing software firms during development of software products in Sudan software industry.

Previous research focused on the software industry in western and southern Africa [32]. However, relatively few studies have been conducted in investigating software development methodologies in Tanzania. Therefore, this study investigated the software development methodologies and practices that has been applied in the software industry in Tanzania and how they affect the success or failure of the software projects.

3. Methodology

3.1 Research Design

The study used questionnaire, semi-structured interviews, and documentary review as data collection instruments. The questionnaire was distributed to 54 respondents (developers and project managers) from 18 different software firms in Dar es Salaam, Tanzania. Out of 18 selected firms, 13 were private owned while 5 were government institutes. The study was conducted in Dar es Salaam as it is a city with the highest number of software development activities. Of the 54 respondents who completed the questionnaire, 14 were project managers, 40 were software developers.

After identifying key issues from questionnaire, interviews were conducted to selected members of project teams. A total of 11 respondents were interviewed from 8 selected software firms out of 18 firms. Finally, official documents which were used during the development of various software were reviewed. Some of the reviewed documents include UBUYU V 2.1 software project report, SIMS software project report, DHIS2 Manuals, NIT Library management system proposal, and Loan board system terms of reference. The study was conducted between March to July 2018.

3.2 Firms by Organizational Size

The selected firms were the firms categorized based on the number of employees. Of 18 surveyed firms, 8 of them were regarded as small firms employed between 1-49 staff, 6 firms were regarded as medium firms employed 50-99 staff, and 4 firms were regarded as large firms as they had more than 100 staff.

3.3 Respondents' Demographic Information

Of 54 respondents who completed the questionnaire, 41 were males while 13 were females. Moreover, the majority of them had bachelor's degree (32 respondents) followed by diploma (10 respondents). Four respondents had certificate in ICT, 6 had master's degree while none of the respondents had doctoral degree.

4. Findings

4.1 Software Development Methodologies Deployed

The study found that various software methodologies were adopted in developing software products and they varied significantly. However, the majority of firms adopted traditional software development methodologies accounting to 51 software products out of 79 surveyed software products. The agile methodologies were the least adopted software methodologies accounting to 8 software products. Figure 1 shows software methodologies adopted in software industry in Tanzania.

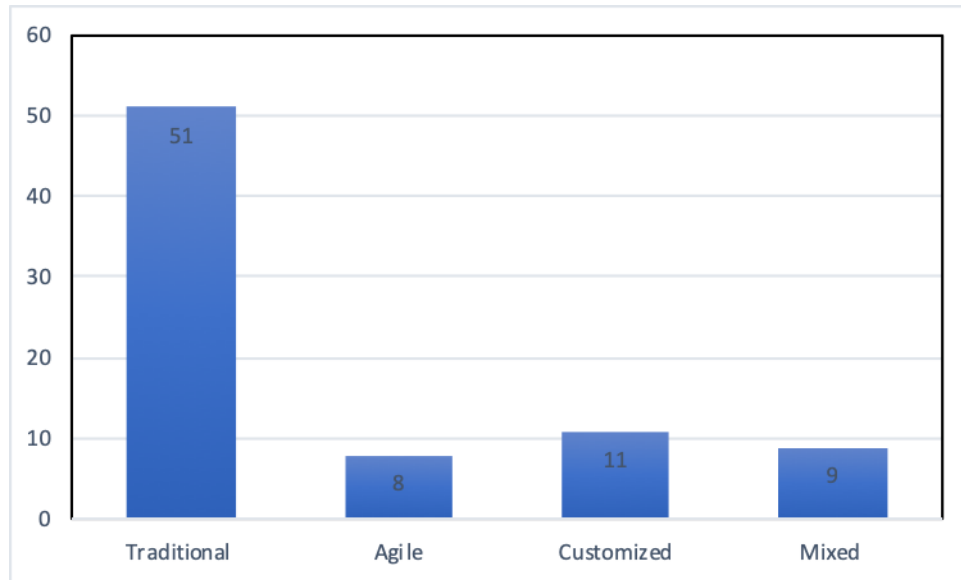


Figure 1: Software Methodologies Adopted in Developing Various Software Products

4.2 Distribution of Traditional Software Methodologies

We were also interested to investigate the types of traditional software methodologies adopted in the software industry in Tanzania. Some developers could not mention which traditional methodology they were using, but one could easily identify the methodology used based on the explanations provided by interviewees. For instance, when asked how do you go about developing the software product, one developer commented:

" We normally meet with clients and discuss exactly what they want the software to do. Sometime clients don't really know what they want so we help them interpreting their requirements. After all parties are clear with the requirements, we proceed with designing the system. Then after designing we move to implementation of the software which involves specifying hardware and system requirements and also helps in defining overall system architecture. We then move to implementation with inputs from designing phase development of the system is done followed by integration and testing of each unit. Once the functional and non-functional testing is done, the product is deployed in the customer environment or hosted in our server." (Developer, DESIAMORE LTD).

From the above explanation, it was clear that the developer adopted waterfall model. Similarly, the based on another interviewee, we were able to categorize the methodology as prototyping.

", ... normally we take user requirement concerning the software, using his idea we generate the software prototype and show him if there any changes we correct it on the prototype then we begin the development. We also advise them what we are supposed to." (Developer, DUXTE LTD).

Moreover, some developers mentioned a different methodology but when asked to explain the process used in the development of the software product, one realizes that it was a different methodology compared to what the developer mentioned previously. For instance, one developer

mentioned that they used waterfall model during the development of one software product but when asked further he commented:

"The first step that we do is gather information from the client on the project that we should work on then after that, software development team we sit down and figure out the reusable libraries and codes that previously created if some tweaks required we do that, then we also sort new things to invent on the project and we divide the work throughout the team. This is done by embracing object-oriented programming."
(Project manager, INETS LTD).

When we set and reviewed the comment later, we noted that this was not waterfall model but Rapid Application Development methodology.

Generally, the findings showed that waterfall model was the most adopted traditional software development methodology with a total of 21 software products out of 51, followed by prototyping with 14 software products, and 7 software products were developed using Rapid Application Development methodology. None of the surveyed firms adopted the V-model development methodology. Figure 2 shows the distribution of traditional software methodologies per software that was developed.

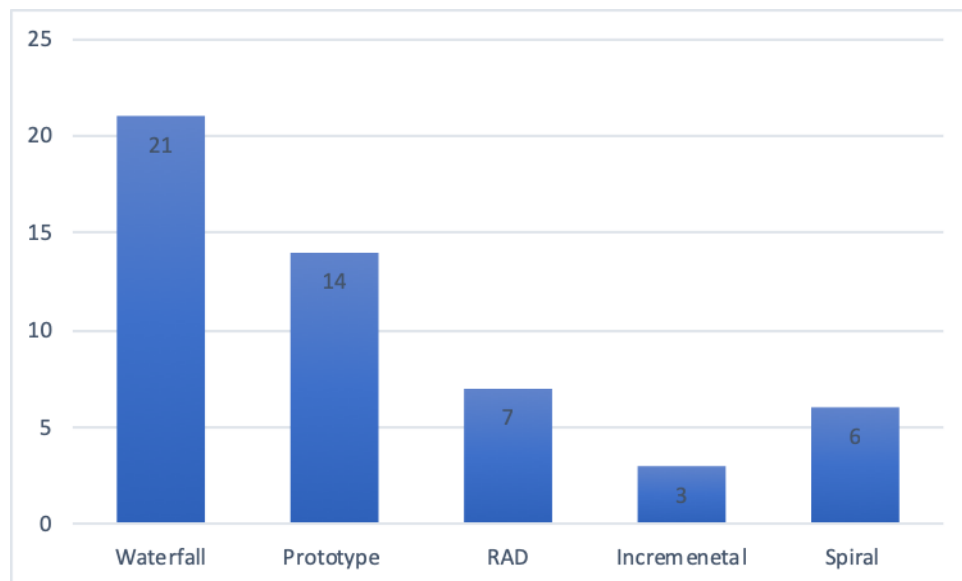


Figure 2: Distribution of Traditional Software Methodologies per Developed Software

4.3 Distribution of Agile Software Methodologies

The study found that the majority of respondents could not mention exactly which agile software methodologies were used during the development process. We combined their explanations with our experience to group them into specific agile methodology. Out of 8 adopted agile methodology, 4 software products were developed using eXtreme programming, 3 were developed using Kanban, and 1 software was developed using Scrum.

We further wanted to know why agile methodologies were not widely used amongst developers in Tanzania. The study found that many developers did not have the knowledge of using agile methodologies. The agile methods seemed to be new to them and therefore they opted to the methods they knew better even if they were not the best methods for the particular software development project. Some of their comments are:

"We once wished to practice agile as it is a new methodology by we couldn't start because we didn't have enough time to start learning a new methodology. It is not easy to shift from the normal methods you always use and start using other methods." (Project manager, INNOVEX).

Due to lack of knowledge of the agile methodologies, some developers perceived them as most costly approaches in developing software products compared to traditional methods. Therefore, they thought it is better to continue with traditional methodologies in order to save the cost.

For instance, one developer commented.

" ... But also speaking the truth, budget is everything in these projects. Sometime a customer provides requirements when you try to compare with budget, you end up choosing a methodology that will be less expensive, like what we are using here, waterfall." (Project manager, INNOVEX).

4.4 Factors Influenced the Selection of Software methodologies

With several software development methodologies in their disposal, it was important to find out reasons behind selecting a particular methodology for a given project. Therefore, respondents were asked to rate which factors amongst listed in the questionnaire influenced in choosing the most adequate methodology for a specific project. The factors were obtained through review of relevant literature such those in [12], [16], [18], [31], [33] as shown in Table 1.

Table 1: Factors Influencing the Selection of a Software Development Methodology

No.	Factor	Source
1.	Nature/type of project	[18] [33]
2.	Project size	[18] [33]
3.	Project duration	[16] [33]
4.	Project complexity	[18]
5.	Level of understanding of user requirements	[33] [12]
6.	Level of understanding of the application area	[33] [12]
7.	Customer involvement	[12], [16], [18], [31]
8.	Experience of developers	[18] [31]
9.	Team size	[16] [12] [31]
10.	Availability of tools and technology	[33] [12]

The study found that many developers rated nature/type of the project influenced the selection of the software development used for a certain software project (36 respondents) followed by level of understanding of the application area (31 respondents), customer involvement (29 respondents), and project size (29 respondents). However, project complexity and project duration were the least rated factors influenced developers in selecting specific development methodology (See Figure 3).

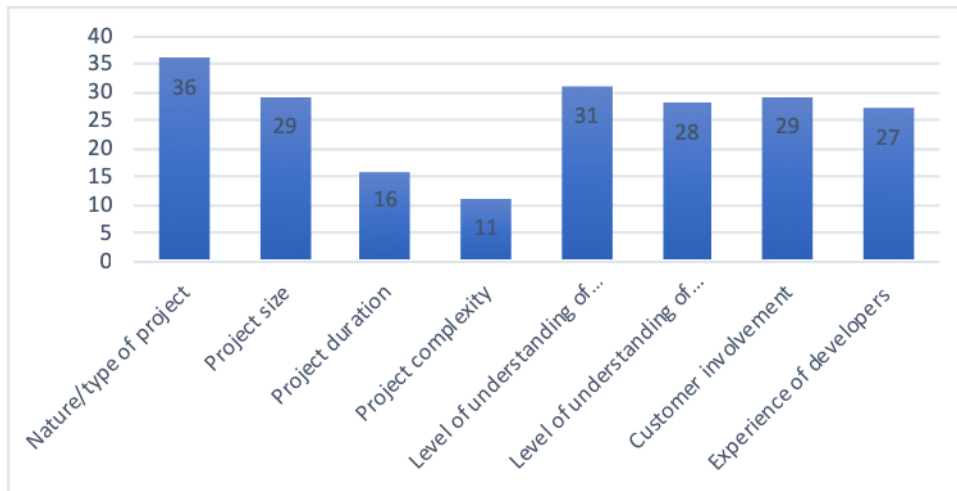


Figure 3: Factors Influenced Developers in Selecting Specific Development Methodology

5. Discussion

The ICT sector has been growing significantly in Tanzania in the last few years. The government like many other African governments recognizes ICT sector as a powerful tool that can boost economic growth by increasing efficiency, providing access to new markets or services, and creating new opportunities for income generation [7]. With these benefits in mind, the government of Tanzania has been making several initiatives to ensure that ICT sector is growing and benefiting almost every sector of the economy. One of the most notable efforts is the formulation of National ICT policy of 2016 which provides a conducive environment for locally developed software products [5], [11]. Other efforts include improvement of ICT infrastructure through optical fibre network namely Eastern Africa Submarine Cable System, and the African Cable System[34] and increased mobile of mobile technology to amounting to 80% of total population [10].

Given these developments, several software firms have been established to solve different societal problems. These firms tend to adopt and use various software development methodologies based on a variety of reasons. Nonetheless, software development methodologies have their own strengths and weaknesses (Balaji, 2012; Tanner et al, 2014). As a result careful selection of software development methodology is required in order to develop software products that meet users expectations [19]. In fact, it is not the chosen methodology per se that drives project risk but how well the selected methodology fits a given project [20].

While software industry in Tanzania is in the rise, there is a need to investigate different types of methodologies and practices used in software industries in Tanzania. The findings of this study will help institutions to understand the gap existing in the software development methodologies they are teaching and the ones applied in the software industry. This study therefore used questionnaire, semi-structured interviews, and documentary review as data collection instruments involving developers and project managers from 18 different software firms in Dar es Salaam, Tanzania.

The study found that the majority of software firms in Tanzania are using traditional software development methodologies accounting to 72% of 79 surveyed software products. Specifically, amongst 51 software products developed using traditional software methodology, nearly half of them (21 out of 51 software products) adopted waterfall model. This finding corroborate with other studies which found that waterfall model being the most adopted and used software

methodology in studies conducted in Sudan [31], and Namibia [21]. These findings clearly show that waterfall model remains to be the most adopted and applied methodology in software industry in Tanzania and other African countries.

A possible explanation is agile methodologies and other new software development methods are not well taught in universities due to poor computer science programs in many universities in sub-Saharan Africa. According to Bezy (2013), many ICT curricula in universities in Africa tend to be outdated. This is to say, new courses such as human computer interaction, mobile development, and new software methods are rarely found in these curricula [35].

The study also found that agile methodologies were the least adopted and applied in the development of software products in Tanzania accounting to 8 out of 79 software products in the surveyed firms. This is contrary to other studies such as those in [12], [36] which found that agile methodologies were the most adopted methodologies in software industry of studied countries. For instance, Politowski et al. (2016) found that 65% of software products were developed through some forms of agile practices. Similarly, Mahanti et al. (2012) found agile methodologies to have a high popularity with 40% of the projects. Therefore, there is a need for developers in Tanzania software industry to be familiar with the current software methodologies in order to build quality software products that meet users' needs. Software firms should develop mechanisms that enable developers to gain new software development skills through professional developments.

It was also revealed that some developers were not sure which methodology they were using in developing software products. However, using our experience we were able to group them into specific categories upon listening carefully on how they approached software development projects. The possible explanation of this finding could be due to the fact that some developers tend to adopt the so-called Build and Fix Model where no specific methodology is followed during software development process. The developers simply build a product that is reworked as many times as necessary based on the given requirements to satisfy the client. Another possible explanation could be that some developers tend to omit certain aspects of methodologies not from a position of ignorance, but from the more pragmatic basis that certain aspects are not relevant to the development environment they face [37]. As a result, if they are asked to explain specific methodologies they are applied in such context, they may not be able to do so.

Moreover, many developers rated nature/type of the project influenced the selection of the software development used for a certain software project (36 respondents) followed by level of understanding of the application area (31 respondents), customer involvement (29 respondents), and project size (29 respondents). However, project complexity and project duration were the least rated factors influenced developers in selecting specific development methodology. These findings are consistent with similar studies such as those of [12], [31] which found nature/type of project were critical factor in choosing software methodology for a particular software project.

6. Limitations

Despite the findings from this study, some limitations are worth mentioning. One notable limitation is that it involved software firms located in Dar es Salaam due to time and resources constraints. Future studies on the current topic are therefore recommended to include a much larger sample of software firms located other regions in Tanzania. Moreover, the study excluded software products outsourced or imported from outside the country and those which were customized from products imported from elsewhere. To develop a full picture of software development activities in Tanzania, future studies should include both locally developed

software and those which are outsourced or procured from outside Tanzania. Notwithstanding these limitations, the study provides an understanding about software development activities that have been taking place by local firms in Tanzania.

7. Conclusion and Recommendations

The ICT sector in developing country is growing and many firms will continue to be established in order to develop solutions that addresses the need of local market. The findings from this study clear pointed out that developers have continued to adopt traditional software development methodologies despite the emergence of several agile and other forms of iterative methodologies. The agile methods, for instance, have been described to enable developers to develop quality software products within a short time while involving users from the onset of the software development project. The findings from this study showed that these methods are rarely applied into software development process in the software industry in Tanzania. Based on the findings from this study the following are recommended:

- There is a need for universities offering software developing courses to engage the industry in curriculum development so that they can include courses that prepare our graduates to develop software that will meet both local and international market.
- Universities should form curriculum review committee which will be reviewing course offerings for any given academic program in order to ensure that new technologies and methods are included in the offered courses.
- Software firms should have plans to provide professional development trainings to its developers so that they can update themselves with current tools, methods, and applications that are relevant to the current software development industry.

References

- [1] InfoDev, "Transforming east african ICT sector by creating a business engine for SME," 2014.
- [2] NBS, "Statistical Business Register Report, 2014/15," 2016.
- [3] S. Dutta and B. Bilbao-Osorio, "The global information technology report 2012," 2012.
- [4] T. Fredriksson *et al.*, "Information Economy Report 2012: The software industry and developing countries," in *United Nations Conference on Trade and Development (UNCTAD)*, 2012, pp. 1–125.
- [5] MWTC, "National Information and Communication Technology (ICT) Policy," Dar es Salaam, Tanzania, 2016.
- [6] D. Opudo, "Tanzania's Startup Ecosystem Has a Brighter Future," *TechinAfrica*, 2018. [Online]. Available: <http://www.techinafrica.com/tanzanias-startup-ecosystem-brighter-future/>.
- [7] M. Bezy, "Africa Oye: Raising the bar in Africa's higher education quality - The impact on the ICT industry and the danger for Africa," 2013. [Online]. Available: <http://brel54.blogspot.com/2013/09/raising-bar-in-africas-higher-education.html>. [Accessed: 16-Jun-2018].
- [8] D. Lillis, F. Mtenzi, D. Mauricaite, S. Jafari, and P. Manifold, "Skills Needs of the ICT Sector in Tanzania Skills," in *First Tanzanian ICT Summit*, 2013, pp. 0–41.
- [9] N. Economides, "Mobile Money in Tanzania," pp. 1–55, 2016.
- [10] TCRA, "January- March 2017 Quarterly Statistics Report," 2017.
- [11] Ø. Sæbø, "E-government in Tanzania : Current Status," *IFIP Int. Fed. Inf. Process.*, pp. 198–209, 2012.
- [12] R. Mahanti, M. S. Neogi, and V. Bhattacharjee, "Factors Affecting the Choice of Software Life Cycle Models in the Software Industry-An Empirical Study," *J. Comput. Sci.*, vol. 8, no. 8, pp. 1253–1262, 2012.
- [13] M. Tanner and U. von Willingh, "Factors Leading To the Success and Failure of Agile Projects Implemented in Traditionally Waterfall Environments," *Hum. Cap. without Bord. Knowl. Learn. Qual. Life. Manag. Knowl. Learn. Int. Conf. 2014*, vol. I, pp. 693–701, 2014.
- [14] S. Balaji, "Waterfall vs v-model vs agile : A comparative study on SDLC," *WATERFALL Vs V-MODEL Vs Agil. A Comp. STUDY SDLC*, vol. 2, no. 1, pp. 26–30, 2012.
- [15] Y. Bassil, "A Simulation Model for the Waterfall Software Development Life Cycle," *Int. J. Eng. Technol.*, vol. 2, no. 5, pp. 2049–3444, 2012.

- [16] C. V. Geambaşu, I. Jianu, I. Jianu, and A. Gavrilă, "Influence factors for the choice of a software development methodology," *Account. Manag. Inf. Syst.*, vol. 10, no. 4, pp. 479–494, 2011.
- [17] J. Sheffield and J. Lemétayer, "Factors associated with the software development agility of successful projects," *Int. J. Proj. Manag.*, vol. 31, no. 3, pp. 459–472, 2013.
- [18] M. K. Alqudah and R. Razali, "Key Factors for Selecting an Agile Method: A Systematic Literature Review," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 7, no. 2, p. 526, 2017.
- [19] V. Balijepally and R. Mahapatra, "Are Two Heads Better Than One for Software Development? The Productivity Paradox of Pair Programming," *MIS Q.*, vol. 33, no. 1, pp. 91–118, 2009.
- [20] A. Tiwana and M. Keil, "The one-minute risk assessment tool," *Commun. ACM*, vol. 47, no. 11, pp. 73–77, 2004.
- [21] G. E. Iyawa, M. E. Herselman, and A. Coleman, "Customer interaction in software development: A comparison of software methodologies deployed in Namibian software firms," *Electron. J. Inf. Syst. Dev. Ctries.*, vol. 77, no. 1, pp. 1–13, 2016.
- [22] M. A. Awad, "A Comparison between Agile and Traditional Software Development Methodologies," *Univ. West. Aust.*, vol. 1, pp. 1–300, 2005.
- [23] T. Ahmed *et al.*, *Developing information systems: Practical guidance for IT professionals*. BCS Learning & Development Limited, 2014, 2014.
- [24] P. Sharma and N. Hasteer, "Analysis of linear sequential and extreme programming development methodology for a gaming application," *Int. Conf. Commun. Signal Process. ICCSP 2016*, pp. 1916–1920, 2016.
- [25] B. Boehm, "Software Development: Get Ready for Agile Methods," *Computer (Long. Beach. Calif.)*, vol. 35, no. 1, pp. 64–69, 2002.
- [26] D. Sunner, "Agile : Adapting to need of the hour: Understanding Agile methodology and Agile techniques," in *2nd International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT)*, 2016, pp. 130–135.
- [27] J. Highsmith and A. Cockburn, "Agile Software Development: The Business of Innovation," *Computer (Long. Beach. Calif.)*, vol. 34, no. 9, pp. 120–122, 2001.
- [28] S. B. Patil, S. Rao, and P. S. Patil, "Agile principles as a leadership value system in the software development," in *Proceedings of the International Conference & Workshop on Emerging Trends in Technology - ICWET '11*, 2011, no. Icwet, p. 765.
- [29] A. El-Deeb, "A view on the state of software engineering practice," *ACM SIGSOFT Softw. Eng. Notes*, vol. 37, no. 6, pp. 1–4, 2012.
- [30] M. M. M. Safwan, G. Thavarajah, N. Vijayarajah, N. Senduran, and C. D. Manawadu, "An Empirical Study of Agile Software Development Methodologies : A Sri Lankan Perspective," *Int. J. Comput. Appl.*, vol. 84, no. V, pp. 7–13, 2013.
- [31] S. Alamdy and R. Osman, "Software Industry Practice in Africa: Case Study Sudan," in *Proceedings - International Computer Software and Applications Conference*, 2017, vol. 1, no. 1, pp. 743–748.
- [32] H. M. Huisman and J. Iivari, "Systems development methodology use in South Africa," in *Proceedings of the 9th Americas Conference on Information Systems*, 2003, pp. 1040–1052.
- [33] Y. Mallawarachchi and S. Jayasena, "The factors that affect the selection & tailoring of software development processes and a correlation analysis of project successes and failures based on the process choice and tailoring decisions." 2006.
- [34] K. F. . Mwakisole, M. M. . Kissaka, and J. S. . Mtebe, "Feasibility of cloud computing implementation for eLearning in secondary schools in Tanzania," *Int. J. Educ. Dev. using Inf. Commun. Technol.*, vol. 14, no. 1, pp. 91–102, 2018.
- [35] J. Mtebe and M. Kissaka, "Enhancing the Quality of Computer Science Education with MOOCs in Sub-Saharan Africa," in *Handbook of Research on Active Learning and the Flipped Classroom Model in the Digital Age*, J. Keengwe and G. Onchwari, Eds. Hershey PA, USA, 2016, pp. 366–377.
- [36] C. Politowski, L. Fontoura, F. Petrillo, and Y.-G. Guéhéneuc, "Are the old days gone? A survey on actual software engineering processes in video game industry," in *Proceedings of the 5th International Workshop on Games and Software Engineering (GAS '16, in conjunction with ICSE 2016), Austin (TX), USA, 16 May\, 2016*, 2016, pp. 22–28.
- [37] B. Fitzgerald, "The use of systems development methodologies in practice a field study," *Info Syst.*, vol. 7, pp. 201–212, 1997.