

# MOBILE DATA COLLECTION TECHNOLOGY AS IMPETUS FOR THE USE OF QUALITY OF CARE (QOC) ASSESSMENT IN NON-FOR-PROFIT FACILITIES

PAULIN TRA , HABIB KHAN TAREEN\*

Graduate Student, Department of Computer Science, The University of Liverpool, Liverpool, UK./

M&E Manager, International Planned Parenthood Federation (IPPF) Africa Region, Nairobi - Kenya

\*Faculty, College of Management and Technology, Walden University, USA.

E-mail: E-mail: [paulin.tra@outlook.com](mailto:paulin.tra@outlook.com), [habib.khan@mail.waldenu.edu](mailto:habib.khan@mail.waldenu.edu)

## ABSTRACT

The increasingly popularization of mobile Technology has contributed in bringing important innovations in businesses regardless the sector. It is in such context that considerable number of professionals recommended to public health organisations operating mainly in low-and-middle-income countries to enhance their Health Information System by integrating Open Data Kit (ODK), a free android open source application with a set of tools. With the knowledge that Quality of Care (QoC) does not operate efficiently in low-and-middle-income countries, this paper discussed how a mobile-based application developed by using XForm and designed on ODK system affected positively the perception of health workers toward QoC assessment. More specifically, the mobile-based QoC assessment tool was significantly found better than the paperwork tool because of its ability to: (1) automatically handle average calculation and scoring; (2) reduce paperwork and ease the availability of the QoC assessment tool anywhere including remote sites; (3) increase data accuracy and availability to support immediate feedback and decisions making; (4) allow very low cost implementation of the QoC assessment initiative. Building then on these findings, the developed IT artefact optimistically has promoted an innovative approach that was able to focus on decentralizing and taking QoC practices up to service delivery points existing at the lowest level including remote sites.

**Keywords:** *Health Information Systems, Quality of Care (QoC), Open Data Kit (ODK), DHIS2, XForm, Developing countries, Net Promoter Score (NPS)*

## 1. INTRODUCTION

It is increasingly understood and accepted by human societies that the advent of sciences has unhidden a number of realities which were for long time ignored by majority of people. One of these realities as underscored by [7], is the acknowledgement of the key roles played by data and information in building human societies. And to this extent, data and information are considered by many professionals as part of the third fundamental entity which is complementary with matter and energy needed to achieve any activities.

In the modern society, information and knowledge have become so important for decisions making that increasingly number of organisations are putting considerable efforts in data collection process as primary inputs for information generation in order to ultimately contribute in building and sustain new

knowledge. However, as elaborated by [25], data become meaningful only when it is adequately collected, pro-cessed and analysed and put into the appropriate context to answer specific questions.

In this regards, it appears clear that every information generation process initially requires the collection of primary and/or secondary data. However, as outlined by [29], it is important to understand the influence of the way data are collected on the quality of the decisions made. To this extent, it is commonly agreed that data collection process should be given careful attention without neglecting and addressing the privacy and ethical issues that might occur. It is probably because data collection is widely acknowledged as the first and most critical process that for long time, many projects took the habit to allocate majority of their resources (financial, material and human) committed for information generation to that phase.

First and foremost, it is important to understand that all the efforts usually put in the initial phase of information generation process aim principally to reduce as much as possible the data collection process to allow quick availability of information that will guide decisions.

Today, with the rapid penetration of mobile technologies at all levels in the modern society, demand for mobile-based data collection for quick generation of raw data is increasingly being given particular attention [22][11][14][20][21][23][24]. In fact, regardless the industry in which people operate, it is observed that accurate and timely data are expected by stakeholders to improve the productivity in a meaningful and sustainable manner.

In healthcare industry, it is observed more and more importance given by public and health professionals to quality of care (QoC) which is also increasingly accepted by searchers and professionals as part of the key drivers to client satisfaction and sustainable financial survival of health industry [4][26][27][28]. This consideration in healthcare industry has created in public and private health organisations a new trend that promotes innovations in quality of care data collection with the aim to contribute in strengthening the health care system.

This new trend regarding QoC has inevitably reached the environment of sexual and reproductive too because this sector has recently become highly competitive with the involvement of more and more profit or non-profit based organisations. It is in such context that the organisation leading sexual and reproductive health and rights i.e. the International Planned Parenthood Federation (IPPF) [12] has recently committed itself to implement QoC in its member affiliates operating in 42 countries in Sub-Saharan Africa Region. Due to the high commitment that IPPF has agreed to demonstrate to Quality of Care, the organisation prior aligned its overall strategic framework 2016-2022 to the principles of Quality of Care and ambition to quickly roll out this initiative in all its member affiliates by the end of 2017.

This paper aims at contributing to suggesting innovative approach involving the use of mobile application that will efficiently support the roll out ambition of IPPF Africa Region of the Quality of Care initiative in 42 countries of Sub-Saharan Africa region.

## 2. PROBLEM STATEMENT

Although quality of care (QoC) is increasingly presented as the most promising trend in a

competitive health industry in general and specifically in the field of sexual and reproductive health, it remains a considerable challenge for economies in Sub-Saharan Africa countries [1][2]. As part of the main reasons of this unfavourable situation for QoC in Sub-Saharan Africa as pointed out by [3], it should be considered (1) low investment in health sector, (2) weak management of resources and (3) low level of accountability, motivation and skill of health providers. To this extent, the com-mon observation in organisations committed now to QoC initiative is the importance given in simplifying as much as possible approaches, tools or strategies related to QoC while operating in developing countries.

It is in such context that IPPF Africa Regional Office launched its first QoC assessment tool developed using MS Excel software but still obliging end-user of that QoC assessment tool to manually handle some complexities such as the identification of the appropriate score and manual calculations while filling the QoC tool. However, referring to the results of the research conducted by [13][29][30][31][32], mobile-based data collection appear to be highly appropriate for complex data collection operations or surveys. Therefore, building on the statements of those who support the use of mobile de-vices for complex data collection, this project has proposed for the first time in IPPF federation the possibility to test mobile-based data collection to improve the QoC assessment operation. In fact, by involving mobile-based data collecting in QoC assessment operation, the ultimate expectation is to improve the availability, timeliness, completeness, accuracy and reliability of the QoC data. In addition, this approach is expecting to render the QoC process more user-friendly and easy to be handled by health workers regardless their levels of skill with the main objective to allow all complexities to be transparently, automatically and adequately handled by mobile application.

The IT artefact tested by the project are mobile-based data collection tools for QoC assessment developed in an open source android application (ODK - Open Data Kit 1.4.10) using principally XForm technology newly developed by W3C (World Wide Web Consortium) to build simple algorithms and using XML (eXtensible Markup Language) when handling algorithms that appear to be more complex.

## 3. LITERATURE REVIEW

The approach adopted to answer the problem posed starts firstly by the development of an IT artefact

aiming to improve the QoC assessment mechanism at the level of the IPPF member affiliate of Kenya (FHOK). The IT artefact is composed of two main functionalities built by using two open source applications.

The entry of QoC data is done by using android mobile devices through an application developed with the ODK (Open Data Kit). As indicated by [13], ODK is an open source program suitable for developing countries where increasingly health services are provided in remote sites, and developed by a group of professionals from the University of Washington which allow considerable flexibility while developing complex questionnaires with the purpose to be implemented on android mobile smartphones or tablets.

On the other hand, the research used the DHIS2 (District Health Information Software) to build the dashboard synthesizing the information resulting from the QoC assessment aiming to support decisions that contribute in improving the quality of care system within a health facility. As outlined by [19] the DHIS2 is an open source web based solution currently widely adopted by majority of government and public health organisations in developed countries initially developed by a group of professional from the University of Oslo. One of the reasons of the quick penetration of the DHIS2 in developing countries its effective ability to build user-defined dashboard with the possibility to include Geographical Information System (GIS) interface.

Figure 1. System design of the Mobile-based Quality of Care Assessment in the two FHOK facilities

Once developed, the IT artefact has been tested in two facilities of IPPF member affiliate of Kenya (FHOK) by using the quasi-experimental design. For this academic research, the quasi-experimental design has appeared as the most appropriate because as high-lighted by research professionals such as [5], such research design is effective to test innovation in a context that do not require the use of randomization. To this extent, the IT artefact has been tested in two health facilities identified (in Nakuru and Eldoret) as the case sites and the QoC mechanism without the IT artefact has been assessed in two other health facilities (Kakamega and Meru) selected as control sites. The particularity of the four facilities it that they have a

lot of similarities in terms of population covered, minimum package of services offered in the facility, the skills and background of the health providers and the facility attendance by the population. The quasi-experimental design adopted in this study includes qualitative and quantitative data with the purpose to objectively highlight the results of the test. While the quantitative data composed essentially of secondary data collected during the use of IT artefact by the two health facilities during two months as well as primary data collected from one on one interviews with the end users, the qualitative data resulted essentially from the “why” question asked during the one on one interviews with the system users and owners after two months of utilization.

Figure 2. Implementing sites

While the secondary data have been firstly collected from ODK (IT artefact) by using an android device, it has secondly been submitted in the web-based platform for compilation before to be finally pushed manually to the DHIS2 platform by the project team to allow users to easily handle further analysis. All the data have been collected directly from the four health facilities by external people composed essentially of students who had never been exposed to any QoC initiative before.

The primary data collected during the final evaluation have been analyzed by using the Net Promoter Score approach and the qualitative data have been analyzed by using qualitative data analysis approaches. The literature table 1 is showing the support of different factors by previous studies.

Table 1: Literature Review Table

#### 4. METHODOLOGY

With the end in mind, the agile system analysis and design implemented by the team in this project was also continuously strengthened through the research methods used in this project. More specifically the research method was summarized around the quasi-experimental study involving case and control groups. In fact, as outlined by [5], the quasi-experimental design methodology is appropriated for studies that seek answers about cause-and-effect relationships.

As recommended by such research methodology, no interventions were carried out in the control sites and the standard MS Excel version of the Quality of Care Assessment tool was used by the health worker as the only one tool that they knew. On the other hand, the IT artefact was exclusively implemented in the case sites.

After having used the different tools during two months (May to June 2016) separately, the two groups were subjected to an evaluation to appreciate the perceptions of the system users and owners in order to further guide the decision regarding the production of the IT artefact. Due to the constraint of time and financial resources, a simple but efficient straight forward evaluation method has been used to collect the perception of the group on the respective Quality of Care assessment that they were using i.e. the Net Promoter Score (NPS). In fact, although the Net Promoter Score is commonly used in very competitive business environment (telecommunication, supermarket, fast food etc.), the project team has contextualized the NPS referring on the fact that increasingly research professional such as [18] argued that it represents one of the most robust and cost-effective methods of measuring quality and performance vis-à-vis customers. To this extent, as highlighted by [16], increasingly number of organisations have adopted the Net Promoter Score to measure their clients' satisfaction in a simple and concise way. And although as underscored by [16], its uses to examine healthcare clients satisfaction is not recommended, the project team did not found any issue in adopting the NPS in this project because the evaluation target exclusively the end users who are either FHOK service providers or headquarter staff members (i.e. they are not healthcare clients).

As elaborated by [16], the NPS is essentially based on one simple question. By contextualizing this question to the project expectation, mainly focused on measuring the satisfaction of the end users of the IT artefact that underpins the IPPF Africa Region Quality of Care Assessment tool in comparison to those who were still using the MS Excel tool, that single question has been rephrased as following: How likely is it that you would recommend the current Quality of Care Assessment tool to a colleague or another health facility? The possible answers to that question have been given score within a range from 0 ('not at all likely') to 10 ('extremely likely') (Fig. 3).

Figure 3. The Net Promoter Score scale

As developed by [16], the interpretation of the NPS was principally underpinned by the following three assumptions: (1) individuals who give a score of 9 or 10 are considered as the most enthusiasts and will always give express positive feeling about the tool (MS Excel or IT artefact of the Quality of Care Assessment tool); and to this extent, they are identified as "promoters". (2) Individuals who give a score of 8 or 7 are indifferent to the use of either the MS Excel tool or the IT artefact of the Quality of Care Assessment tool; they are then called "passives". (3) Finally, Individuals who give a score between 0 and 6 are not happy about the Quality of Care Assessment tool and will always express negative feeling about the tool; these participant are qualified as "detractors".

The Net Promoter Score is represented then by the percentage of "promoters" from which the percentage of "detractors" is subtracted. Referring to the statement underscored by [18], it appears that when the NPS is 80 percent or higher, the practice considered as highly appreciated by the majority of users. However, when the NPS is less than 80 percent, it is recommended to collect specific feedback and comments from the clients or end users.

## 5. TECHNICAL IMPLEMENTATION

The technical implementation of the IT artefact has been achieved by completing the following steps: (1) application development, (2) system installation, (3) configuration and, (4) test, training and deployment.

Regarding the application development it is important to understand that one of the particularities of the system developed in this project is the fact that it is composed of mobile and web interface. However, the developed application is principally a native mobile application operating in Android operating system. The web platform allows to handle both the web interface of the application as well as all the back end operations including attribution of permissions to the levels of users (administrators and users) and controlling and managing all the data.

Referring on the structure of the Quality of Care Assessment tool as initially developed by IPPF Africa Region, the MS Excel tool developed by

IPPF Africa Regional Office is composed of five independent sections: (1) Service Provision, (2) Programme Management, (3) Integrated Package of Essential Services in Static Clinic, (4) Non-static Service Delivery Point, (5) Cumulated Scores. To this extent, the mobile application developed is composed of five independent modules with each handling the quality of care assessment process for the different sections.

The development initially started in a MS Excel tool which has been set up to fully comply with XForm design principles. As part of this set up, firstly three Excel sheets have been created (“survey”, “choices”, and “settings”). In the “survey” sheet, seven columns have been created (“type”, “name”, “label::English”, “hint::English”, “appearance”, “required”, “calculation”); in the “choices” sheet, three columns have been created (“list\_name”, “name”, “label::English”); and in the “settings” sheet, two columns have been created (“title”, “id\_string”). The second series of actions were conducted to build codes in each appropriate columns using XForm programming language (example: `if({scoreck01}<= 33, 1, if({scoreck01}>=34 and {scoreck01}<=66, 2, if({scoreck01} >=67,3,2))`) in one cell in the calculation column) (Fig. 4).

Figure 4. Application development process in MS Excel

On the other hand, the flexibility of the web platform used to develop the mobile application was also giving the opportunity to undertake further and specific development in XML language by simply using Notepad++ (Fig. 5).

Figure 5. Application development process using XML language

After the development of each of the module of the mobile application for the Quality of Care Assessment, the Excel files have been uploaded one by one into the web platform which automatically handle at the backend the generation of the database (Fig. 6).

Figure 6. Uploaded sections of the mobile application

This web platform (<https://ona.io/>) gives also the opportunity to automatically generate the data entry

form which can be used to run the first test before the final set up in the android OS.

Concerning the application installation, this can only be done from an android OS regardless the type of android device used (Smartphone or tablet). The main application i.e. “ODK Collect 1.4.10” was then downloaded and installed on the android device using “Play Store”. This process is usually completed without any interruption and the end users have to just follow the instructions given during the installation.

After the installation, the configuration of the mobile application has to be handled to allow the establishment of the link between the mobile application and the modules prior uploaded into the web platform. To this extent, the URL is just provided to the mobile application (Fig. 7).

Figure 7. System configuration in the mobile application

Once the configuration is completed, the different modules representing the Quality of Care sections have been downloaded from the Web platform to the mobile application by using the “Get Blank Form” button from the main menu, selecting the five sections and clicking on “Get Selected”. During all the downloading process, it is a must to be connected to Internet (Fig. 8). However, the Internet connection is no longer needed when all the forms have been fully downloaded in the mobile application.

Figure 8. Downloading process of the forms from the Web platform

It is after the final installation and configuration of the mobile application that the project team in collaboration with IPPF Africa Region committee member undertook different levels of tests to make sure that the application operate in terms of scoring, exactly as the scoring guidance of IPPF (Tab. 2).

Table 2 Scoring guidance of IPPF Quality of Care Assessment Tool

The training has given the opportunity to the system users identified from the two facilities selected as case (Eldoret and Nakuru) to practices intensively the mobile application on the Quality of Care Assessment tool of IPPF Africa Region. The same training has been also given to some Africa

Regional Office colleagues who were not part of the project. In total, 20 people have been trained on the mobile application. The project team used the opportunity of that training to collect additional comments in order to continue to improve the mobile application before the final deployment which happened early in May 2016.

## 5. RESULTS AND DISCUSSION

The deployment of the mobile application of the Quality of Care tool in Nakuru, Eldoret, FHOK Headquarter and IPPF Africa Regional Office has been just followed by the deployment of the MS Excel tool in Kakamega and Meru under the same initiative by the Quality of Care committee of IPPF Africa Region. In this regards, a period of two months have been finally given to the two groups of users to fully practice the tools underpinning differently the same Quality of Care assessment initiative.

It is after these two months that a survey has been conducted from 4th to 8th July 2016 in the four health facilities as well as at FHOK headquarter and IPPF Africa regional Office by six external students recruited and trained for that purpose.

Referring on the fact that just five staff have been trained in each site (Nakuru, Eldoret, Kakamega, Meru, FHOK headquarter and IPPF Africa Regional Office) during the deployment, the project team has taken the decision to target all of them during the final evaluation of their perception on the tools. To this extent, a total of 30 staff were targeted during the data collection process.

Table 3 Repartition of participants to the final evaluation

Due to the limited number of targeted people at each site level, it has not been found relevant to conduct focus group discussions. However, two opened questions added to the questionnaire has given opportunity to participants to openly provide some addition-al information. In fact, referring on the Net Promoter Score approach used in this project, it was possible to ask just one question. However, the project has judged important to also add some qualitative dimensions into that approach. In this regards, the questionnaire was composed of three questions: (1) How likely is it that you would recommend the current Quality of Care Assessment tool to a colleague or another health facility (by

providing a score between 0 to 10)? (2) Why? (3) Please, share with me a story which support your statement.

Referring to the small sample size of participants who were interviewed, the answers have been analyzed just looking at the groups as control (20 participants) and case groups (10 participants). As highlighted by the responses successfully collected (Appendix D), all the targeted people provided response to at least the first question (Q1) which capture the key information needed for the survey because of the Net Promoter Score (NPS) approach adopted to measure the end users satisfaction for the MS Excel tool and the IT artefact of IPPF Quality of Care assessment initiative.

Analysis of data collected in the control sites highlighted that regarding the MS Excel tool developed by IPPF Africa Region to operate the Quality of Care assessment in their health facilities, out of 10 staff interviewed, 1 staff (10%) responded as a promoter, 4 staff (40%) responded as passive and 6 staff (60%) responded as detractors and were not really favourable to further promote the MS Excel tool of the Quality of Care assessment. By using answers, the calculated NPS for the control group was -50% (NPS=10%-60%). This result underscores that in the control group, the staff members did not perceive relevant enough to promote the Quality of Care assessment tool using an MS Excel sheet.

More specifically, the summary of the main reasons invoked by the staff identified as promoter in the control group was that the fact to now have a tool to assess the Quality of Care in each health facility is very positive because for this person, it is a considerable innovation which will definitely make FHOK facilities to become more competitive. However, 6 staff members qualified to be considered as detractors highlighted that for them the MS Excel tool was very difficult to manipulate essentially when during the assessment operation, the observer has to undertake average calculation at every steps as well as fill the scores base on the complex conditions set in the instructions sheet. Furthermore, the analysis of verbatim gathered in the control group outlined that in general, this group found that the tool Quality of Care assessment tool is good and quite comprehensive, but using the MS Excel tool to generate the appropriate score for each check requires a lot of resources specially the time. Indeed, these two statements provided by two different participant to

the final evaluation emphasize on the gaps: “There are cases where I would over score and other cases where I underscore only to realize later on that I had to re-do the scoring from a fresh” and “I have failed to complete the form several time as it takes a lot of time and I had not much time for this assessment”.

On the other hand, the analysis of the case group composed exclusively of staff members that were using the IT artefact developed to undertake the Quality of Care assessment activities in IPPF Africa Region facilities, revealed that out of 20 staff members, 17 staff members (85%) responded as promoters, 3 staff members (15%) responded as passive and none of them behave as detractors. To this extent, the calculated NPS for the case group was 85% (NPS=85%-0%). Referring to the statement of professionals such as [18] who are intensively using the NPS, when its rating is more than 80%, then the practice can be considered as a strong one. In this regards, this results clearly highlights that the IT artefact underpinning IPPF Africa Region Quality of Care assessment initiative was highly appreciated by the majority of staff reached.

Due to the fact that before this project, all the staff member composing the case group were exposed to the MS Excel tool of the Quality of Care, it was quite easy for them to generate their perception on the IT artefact developed for the Quality of Care assessment because they were always comparing that tool to the MS Excel tool. Therefore referring to this comparison, the statements of the promoters were essentially summarized as following: (1) the IT artefact was automatically handling the calculation and the scores which were generated immediately, rendering then the Quality of Care assessment to move smoothly and easily; (2) With the IT artefact, there was no possibility to omit a standard because all check were compulsory to be answered before to move to the next one, (3) With the IT artefact, the Quality of Care assessment can be completed anywhere without any need to print the forms which avoid much paperwork during the process. These two testimonies retrieved from the verbatim gathered in the case group underscores the major changes that the IT artefact brought in the facilities: “We used to take a very long time to complete the paper based Quality of Care questionnaires as compared to the mobile application” and “The mobile application of the Quality of Care allow now the clinic to

systematically get scores and work on the recommendations immediately”.

The role of project sponsors is so important to any project that project management professionals commonly acknowledge that their level of involvement in a specific project can lead to its failure or success [15]. In this regards, with the ultimate objective to get project sponsors’ buy-in referring to the final results of the project, a meeting has been organized on the 20th July 2016 by the project team to present the preliminary results of the final evaluation of the project and discuss the possible supports that could expected from the project sponsors for the way forward.

In fact, building on project expectations as agreed with the project sponsors essentially composed of IPPF Africa Regional Office Senior Management Team members, the presentation of the preliminary results during the meeting with the project sponsors has clearly highlighted that the IT artefact for the Quality of Care assessment was well appreciated by the staff exposed to that. Since the main point of the appreciation of the IT artefact was its considerable contribution in simplifying the Quality of Care assessment operation, the project sponsors concluded that this IT artefact will definitely help to roll out quickly this initiative in Africa Region. To this extent, the project sponsors have taken the commitment to secure the appropriate resources and budget, to motivate the member affiliate of IPPF across the Africa Region to adopt this change regarding IPPF Quality of Care assessment tool and to enhance the working relationship between this initiative and the other departments or units of IPPF Africa Regional Office.

## 6. CONCLUSION AND RECOMMENDATIONS

The mobile-based Quality of Care assessment initiative has finally attracted more interest from IPPF Africa Region stakeholders than what the project team was expecting. In this regards, the dynamism resulted from the entire project has considerably contributed in building some lessons as following:

(1) Continuous consultations as key requirement in problem-solving IT public health project: The development of innovation projects such as the mobile-based Quality of Care assessment initiative requires continuous and permanent consultations

with the system owners and system users throughout all the phases to increase the project successfulness. In fact, with consideration that focus should be put firstly on clients, the agile analysis and design methodology appears to be the most appropriate for such project.

(2) Mobile technology and smartphone devices penetration contribute in rendering the project environment more conducive: Referring to the fact that the IT artefact operates in an Open Source android application easily downloadable from Play Store, it has appeared that the acceptance of the mobile-base Quality of Care assessment tool was higher in areas where mobile technology and smartphone devices were already popularized.

(3) IT artefact reduces artificial barriers between end users and the paper documents: The IT artefact has come as a good answer to complains from majority of Quality of Care assessment tool users about the number and the volume of paper documents to print and to manage during each assessment operation. In addition, end users who were not confident about calculation were expressing some kind of fear towards the paper documents. With the current IT artefact, end users do not need to worry about the calculation and scoring process.

(4) Mobile-based IT artefact increases cost effectiveness in Quality of Care roll out: Although the project essentially allows the IT artefact to be piloted in two facilities of IPPF Member Affiliate of Kenya, with the ultimate objective to roll out the Quality of Care assessment initiative in Africa Region, the project sponsors are satisfied because with the developed Mobile-base Quality of Care assessment tool, they feel that the roll out objective has become quite possible.

(5) Permanent test platform for more practice: During the deployment of the IT artefact in the two FHOK facilities selected as case, all the participants expressed the need to install also the application on their personal telephone to allow them to practice the mobile-based Quality of Care assessment in permanence or at any time if they need. To this extent, it has appeared important to develop a platform test in parallel to give opportunity to the system users to continuously practice the tool without affecting the integrity of the “real” data.

(6) More time is needed in such project: Due to the considerable interest that IPPF stakeholders are showing to the project, more time and resources are needed to further improve the system by automatically linking the collected data with the DHIS2 platform to run further analysis and designed customized dashboards that can easily support decision making. The current link with the DHIS2 platform is done through manual push of data.

The rapid adoption of smartphone during the current decade in developing world has given the opportunity to organisations and government to strengthen their information system in innovative and low cost manner [17]. The IT artefact underpinning the Quality of Care assessment as developed in this paper represents undeniably a low cost and innovative solution that have been well appreciated by the sponsors, the end users and system owners. However, some recommendations need to be considered to contribute in maintaining the good momentum created around this initiative:

(1) Although the mobile application can considerably enhance the Quality of Care assessment initiative in IPPF Africa Region, it is important to firstly dedicate appropriate time for developing a comprehensive user guide of the IT artefact. That action is important to be undertaken because is clearly acknowledged that the knowledge of majority of IPPF health workers and stakeholders in Information Technology is quite low.

(2) Referring on the fact that more and more end users expressed the need to be allowed to practice the mobile-based Quality of Care assessment tool developed by this project at any time, it appears important to mobilize additional resources to develop a test platform similar to the live one.

(3) The IT artefact being a considerable innovation supporting the Quality of Care assessment tool which is also an innovation, it is advisable according to IPPF Africa Region past experiences in promoting innovation in low income countries, to identify one focal point person for this IT artefact in each member affiliate of IPPF Africa Region. The focal point persons identified will be in charge of maintaining the interest toward the IT artefact and providing the first level of assistance when need be.



(4)Ownership of the IT artefact being an important aspect to be fulfilled across the Africa Region for successful roll out operation of the IT artefact, it is recommended to increasingly use peer to peer approach for trainings and technical supports. Indeed, in public health this technique use generally used to increase ownership at end users level principally when the initiative is new.

On the other hand, referring to considerable gaps that Sub-Saharan Africa Region is facing in terms of Health Information system, the specificity of ODK can offer the opportunity to develop a large and varied set of cost-effective applications suitable for developing countries [9]. To this extent, future researches can ambition to use the system architecture of ODK to continue to promote the adoption and penetration in public health programmes.

#### REFERENCES:

- [1] Adindu, A. (2010). Assessing and Assuring Quality of Health Care in Africa. *African Journal of Medical Sciences*, vol. 3, number 1, pp. 31 -36. ISSN: 2141-0151, Nigeria.
- [2] Brunette, W., Sundt, M., Dell, N., Chaudhri, R., Breit, N. and Borriello, G. (2013). *Open Data Kit 2.0: Expanding and Refining Information Services for Developing Regions*. Department of Computer Science and Engineering, University of Washington
- [3] Bryan, L., Conway, M., Keesmaat, T., McKenna, S. and Richardson, B. (2010). *Strengthening sub-Saharan Africa's health systems: A practical approach*. McKinsey & Company. Available on the Internet at: [http://www.mckinsey.com/insights/health\\_systems\\_and\\_services/strengthening\\_sub-saharan\\_africas\\_health\\_systems\\_a\\_practical\\_approach](http://www.mckinsey.com/insights/health_systems_and_services/strengthening_sub-saharan_africas_health_systems_a_practical_approach) (Accessed: 04/12/2016)
- [4] Buttell, P., Hendler, R., & Daley, J. (2008). *Quality in healthcare: concepts and practice. The business of healthcare*. Westport (CT): Praeger. [Online] Available at: [http://healthcarecollaboration.typepad.com/healthcare\\_collaboration\\_/files/quality\\_buttell.pdf](http://healthcarecollaboration.typepad.com/healthcare_collaboration_/files/quality_buttell.pdf) (Accessed: 05/05/2016)
- [5] DePoy, E. and Gitlin, L. N. (2011). *Introduction to Research: Understanding and Applying Multiple Strategies*. Mosby, Inc., an affiliate of Elsevier Inc.
- [6] Alkendi, A.S., Khan, H.U., Uwemi, S. (2019). "E-Health, Electronic Medical Record System, Patients, And Healthcare Industry", *Academics World 138th International Conference*, Toronto, Canada, 28th -29th July, 2019, pp: 21-24. (Conference Proceeding).
- [7] Gitt, W. (1997). *In the Beginning was Information*. Christliche Literatur-Verbreitung e. V., 1st English Edition
- [8] Heang, F.J., Khan, H.U.,Kamal, D., Uwemi, S. (2019). "Internet Marketing Future And Chinese Agricultural Industry: A Case Study Approach", *Academics World 138th International Conference*, Toronto, Canada, 28th -29th July, 2019, pp: 25-27. (Conference Proceeding).
- [9] Hartung, C., Anokwa, Y., Brunette, W., Lerer, A., Tseng, C. and Borriello, G. (2010). *Open Data Kit: Tools to Build Information Services for Developing Regions*. ICTD2010 December 13-15, ACM 978-1-4503-0787.
- [10] Alkendi, A.S., Khan, H.U., Uwemi, S. (2019). "E-Health, Electronic Medical Record System, Patients, And Healthcare Industry", *International Journal of Advances in Science Engineering and Technology*, Vol.7, No.3, pp: 100-103.
- [11] Heang, F.J., Khan, H.U.,Kamal, D., Uwemi, S. (2019). "Internet Marketing Future And Chinese Agricultural Industry: A Case Study Approach", *International Journal of Advances in Science Engineering and Technology*, Vol.5, No.9, pp: 115-118.
- [12] International Planned Parenthood Federation (2008). *Sexual rights: an IPPF declaration*. IPPF, UK Registered Charity No. 229476.
- [13] Jeffrey-Coker, F., Basinger, M., & Modi, V. (2010). *Open data kit: Implications for the use of smartphone software technology for questionnaire studies in international development*. Columbia University Mechanical Engineering Department. [Online] Available on: <http://sel.columbia.edu/assets/uploads/blog/2013/06/Open-Data-Kit-Review-Article.pdf> (Accessed: 11/01/2021).
- [14] Samad,H.S.I.A., and Khan, H.U. (2018), "Adoption Of Cloud In Enterprises Environment", *International Conference on Innovations in Engineering, Technology and Sciences (IEEE Conference)*. September 20th – September 21st, 2018. (Conference Proceeding).
- [15] Kerzner, H. (2009). *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*, 10th Edition. John Wiley & Sons, Inc.

- [16] Krol, M. W., de Boer, D. Diana M. Delnoij and Rademakers, J. J. D. M. (2014). The Net Promoter Score – an asset to patient experience surveys? John Wiley & Sons Ltd Health Expectations, 18, pp.3099–3109. doi: 10.1111/hex.12297. Laureate online library.
- [17] Macharia, P., Muluve, E. and Lizcano, J. (2013). Open Data Kit, A Solution Implementing a Mobile Health Information System To Enhance Data Management In Public Health. IST-Africa 2013 Conference Proceedings, IIMC International Information Management Corporation. Laureate online library.
- [18] Mackintosh, D. (2015). Net promoter scores: monitoring practice performance. Journal of the British Veterinary Association. Practice 2015; 37:370-372 doi:10.1136/inp.h2645. Laureate online library.
- [19] Many, A., Braa, J., Øverland, L. H., Titlestad, O. H., Mumo, J., & Nzioka, C. (2012). National roll out of District Health Information Software (DHIS 2) in Kenya, 2011–Central server and Cloud based infrastructure. In IST-Africa 2012 Conference Proceedings (Vol. 5). [Online] Available at: <http://www.uio.no/studier/emner/matnat/ifi/INF5761/v15/timeplan/many-et-al.-2012-national-roll-out-of-district-health-information-s.pdf> (Accessed: 11/04/2016)
- [20] Johannes, F., and Khan, H.U., (2017), “IT-Business Strategies Alignment In Strategic Planning”, 2017 DSI Annual Meeting in Washington, D.C., USA. November 18th – November 20th, 2017. (Conference Proceeding).
- [21] Samad, H.S.I.A., and Khan, H.U., (2017), “Adoption Of Cloud In Enterprises Environment”, 2017 DSI Annual Meeting in Washington, D.C., USA. November 18th – November 20th, 2017.
- [22] Park, J. (2015). The Evaluating a mobile data-collection system for production information in SMEs. Elsevier, Computers in Industry 68, 53–64. Laureate online library.
- [23] Khan H.U., Gadhoun, Y.(2018), “Measuring Internet Addiction In Arab Based Knowledge Societies: A Case Study Of Saudi Arabia”, Journal of Theoretical and Applied Information Technology, Vol. 96, No. 6, pp: 1500:1518..
- [24] Khan H.U., Awan M.A.(2019), “Can IT Industry Merger and Acquisition Effect on Brand Equity of their product/services? A case study from Qatar”, Journal of Engineering and Applied Sciences, Vol 14, No. 3., pp:1001-1013.
- [25] Ross, T. K. (2013). Health Care Quality Management. Somerset, US: Jossey-Bass. Laureate online library.
- [26] Khan H.U., Awan M.A.(2017), “Possible Factors Affecting Internet Addiction: A Case Study of Higher Education Students of Qatar”, Int. J. of Business Information Systems (IJBIS), Vol.26, No.2 pp.261:276.
- [27] Brock, V. F. and Khan H.U. (2017a), “Big data analytics: does organizational factor matters impact technology acceptance?”, Journal of Big Data, Vol.4, No.1, pp.1:28.
- [28] Najmi E., Hashmi K., Malik Z., Rezgui, A., Khan H.U.(2014), “ConceptOnto: An upper ontology based on Conceptnet”, 11th ACS/IEEE International Conference on Computer Systems and Applications (AICCSA' 2014), November 10-13, 2014, Doha, Qatar, PP.366-372 (Conference Proceeding).
- [29] Awan, M. A., Khan, H. U. & Ho, H. C. (2016), “Online Banking: A Comparative Study Of Chinese And Saudi Customers Perceptions Of Service Quality”, Journal of Internet Banking and Commerce, vol. 21, no. S5, pp. 1-31.
- [30] Khan, H.U. and Adediji, O.A. (2017) ‘Need for RADAR system utilisation for maritime traffic management: a case of Congo River Basin’, Int. J. Computational Systems Engineering, Vol.3, No. 3., pp163:174
- [31] Khan, H.U., Bankole, O.A. and Alomari, M.K. (2017b) ‘Possible effect of IT introduction into the election process: a case study of Nigeria’, Int. J. Business Forecasting and Marketing Intelligence, Vol. 3, No. 2, pp.109-129.
- [32] Saied, D.E.E.L., Khan, H.U. (2017) ‘Implementation of Health Information System- A case study of Magrabi hospitals, KSA’, Journal of Computer Science, Vol. 13. No. 5., pp. 91-104.
- [33] Awan, M. A., Khan H.U. and Zhang, W. (2012) ‘A comparative study on Online Service Quality Perception of two Major Regional Economies’, *International Journal of e-Education, e-Business, e-Management and e-Learning (IJEEEE)*, Vol. 2, No.6, P.529-551.
- [34] Khan, S., Nazir, S., Khan, H. U. (2021). ‘Analysis of Navigation Assistants for Blind and Visually Impaired People: A Systematic Review’, IEEE Access, doi: 10.1109/ACCESS.2021.3052415.

- [35] Khan, S., Nazir,S., Khan, H. U., Hussain,A. (2021). ‘Pashto Characters Recognition Using Multi-Class Enabled Support Vector Machine’, Computers, Materials & Continua, forthcoming.
- [36] Khan, S., Nazir,S., Khan, H. U. (2021). ‘Smart Object Detection and Home Appliances Control System in Smart Cities’, Computers, Materials & Continua, Vol. 67, No. 1, pp: 896-915. doi: 10.32604/cmc.2021.013878.
- [37] Khan, R. A., Khan, S. U., Khan H. U., Ilyas, M. (2021). ‘Systematic Mapping Study on Security Approaches in Secure Software Engineering’, IEEE Access, doi: 10.1109/ACCESS.2021.3052311.
- [38] Khan, S., Nazir,S., Khan, H. U. (2021). ‘Smart Object Detection and Home Appliances Control System in Smart Cities’, Computers, Materials & Continua, Vol. 67, No. 1, pp: 896-915. doi: 10.32604/cmc.2021.013878.
- [39] Rahman, H. U., Raza, M., Afsar, P., Khan, M., Iqbal,N., Khan, H. U. (2021), ‘Making the Sourcing Decision of Software Maintenance and Information Technology’, IEEE Access, vol. 9, pp. 11492-11510, 2021, doi: 10.1109/ACCESS.2021.3051023.
- [40] Hussain, M., Khan, H. U. , Khan, A. W., Khan, S. U. (2021). ‘Prioritizing the Issues extracted for Getting Right People on Right Project in Software Project Management From Vendors’ Perspective,” IEEE Access, vol. 9, pp. 8718-8732, 2021, doi: 10.1109/ACCESS.2021.3049226.
- [41] Amin, J. , Sharif,M., Anjum, M. A., Khan, H. U. , Malik, M. S. A. and Kadry, S. (2020). ‘An Integrated Design for Classification and Localization of Diabetic Foot Ulcer Based on CNN and YOLOv2-DFU Models’, IEEE Access, vol. 8, pp. 228586-228597, doi: 10.1109/ACCESS.2020.3045732.
- [42] Anjum, M. A., Amin, J. , Sharif,M., Khan, H. U. , Malik, M. S. A. and Kadry, S. (2020). ‘Deep Semantic Segmentation and Multi-Class Skin Lesion Classification Based on Convolutional Neural Network’, IEEE Access, vol. 8, pp. 129668-129678, 2020, doi: 10.1109/ACCESS.2020.3009276.
- [43] Sharif,M., Amin, J. , Siddiqa, A., Khan, H. U. , Malik, M. S. A., Anjum, M. A., and Kadry, S. (2020). ‘Recognition of Different Types of Leukocytes Using YOLOv2 and Optimized Bag-of-Features’, IEEE Access, vol. 8, pp. 167448-167459, 2020, doi: 10.1109/ACCESS.2020.3021660.
- [44] Naeem, M. A., Mirza, F., Khan, H. U. , Sundaram, D. , Jamil, N. and Weber, G. (2020) ‘Big Data Velocity Management–From Stream to Warehouse via High Performance Memory Optimized Index Join’,IEEE Access, vol. 8, pp. 195370-195384, doi: 10.1109/ACCESS.2020.3033464.
- [45] Zehra, W., Javed, A.R., Jalil, Z. et al. (2021). ‘Cross corpus multi-lingual speech emotion recognition using ensemble learning’, Complex Intell. Syst., doi:10.1007/s40747-020-00250-4.
- [46] Rahman, H. U., Raza, M., Afsar,P., Khan, H. U. and Nazir, S. (2020) ‘Analyzing Factors That Influence Offshore Outsourcing Decision of Application Maintenance’, IEEE Access, vol. 8, pp. 183913-183926, 2020, doi: 10.1109/ACCESS.2020.3029501.
- [47] Khan, H.U. and Samad, H.S.I.A. (2020) ‘Enterprise strategic shift of technology: cloud-based systems verses traditional distributed system’, Int. J. Enterprise Network Management, Vol. 11, No. 4, pp.320–346.
- [48] Tahir, A.; Chen, F.; Khan, H.U.; Ming, Z.; Ahmad, A.; Nazir, S.; Shafiq, M. A Systematic Review on Cloud Storage Mechanisms Concerning e-Healthcare Systems. Sensors 2020, 20, 5392.
- [49] Naeem, M. A., Mirza, F., Khan, H. U. , Sundaram, D., Jamil, N., Weber, G. (2020) ‘Big Data Velocity Management–From Stream to Warehouse via High Performance Memory Optimized Index Join’, IEEE Access, vol. 8, pp. 195370-195384, 2020, doi: 10.1109/ACCESS.2020.3033464.
- [50] Liao,B., Ali,Y., Nazir, S.,He, L., Khan, H. U. (2020) ‘Security Analysis of IoT Devices by using Mobile Computing: A Systematic Literature Review’, IEEE Access, Vol. 8, PP:120331-120350, doi: 10.1109/ACCESS.2020.3006358.
- [51] Naeem, M.A., Khan, H. U., Aslam, A. , Jamil, N. (2020) ‘ Complexity of Deep Convolutional Neural Networks in Mobile Computing’, Complexity,Vol.2020, pp: 1-8. doi:org/10.1155/2020/3853780
- [52] Feng,C., Adnan, M., Ahmad, A., ULLAH, A. , Khan, H.U. (2020) ‘Towards an Improved Energy Efficient and End-to-End Secure Protocolfor IoT Health Care Applications’, Security and Communication Networks, Vol. 2020, PP:1-9. https://doi.org/10.1155/2020/7063681
- [53] Sharif, M., Amin, J. , Siddiqa, A. Khan, H. U., Malik, M. S. A. , Anjum, M.A., Kadry, S.

- (2020) 'Recognition of Different Types of Leukocytes using YOLOv2 and Optimized Bag-of-Features', IEEE Access, Vol. 8, pp:167448-167459. doi: 10.1109/ACCESS.2020.3021660.
- [54] Naeem, M.A.; Khan, H.U.; Aslam, S.; Jamil, N. Parallelisation of a Cache-Based Stream-Relation Join for a Near-Real-Time Data Warehouse. *Electronics* 2020, 9, 1299. doi.org/10.3390/electronics9081299.
- [55] A.A. Anjum, J. Amin, M. Sharif, H.U. Khan, S.A. Malik, S. Kadry. (2020) "Deep Semantic Segmentation and Multi-Class Skin Lesion Classification based on Convolutional Neural Network" in IEEE Access, Vol. 8, PP:129668-129678, doi: 10.1109/ACCESS.2020.3009276.
- [56] R Rahmat, S. Nazir, H.U. Khan, I. García-Magariño, R. Amin. (2020) "Augmented Reality interface for complex anatomy learning in the central nervous system: a systematic review" in *Journal of Healthcare Engineering*, Vol.2020, pp:1-15, doi.org/10.1155/2020/8835544.
- [57] J. Li, A. Ullah, J. Li, S. Nazir, H.U. Khan, H.U. Rahman, A.U. Haq. (2020) "Attributes based decision making for selection of requirements elicitation techniques using the Analytic Network Process" in *Mathematical Problems in Engineering*, Vol. 2020, PP:1-13. doi 10.1155/2020/2156023.
- [58] Gill A.Q., Beydoun G., Niazi M., Khan H.U. (2020) Adaptive Architecture and Principles for Securing the IoT Systems. In: Barolli L., Poniszewska-Maranda A., Park H. (eds) *Innovative Mobile and Internet Services in Ubiquitous Computing. IMIS 2020. Advances in Intelligent Systems and Computing*, vol 1195. Springer, Cham.
- [59] Nazir, S., Khan, S., Khan, H.U., Ali, S., García-Magariño, I., Atan, R., Nawaz, M. (2020) "A comprehensive analysis of healthcare big data management, analytics and scientific programming", IEEE Access, Vol. 8., DOI 10.1109/ACCESS.2020.2995572.
- [60] Li, M., Shah, N., Khan, H.U., Shahzad, S., Amin, R. (2020) 'Modelling features-based birthmarks for security of end-to-end communication system', Security and Communication Networks, Special issue: Machine Learning and Applied Cryptography (MLAC), Vol. 2020, PP:1-9, <https://doi.org/10.1155/2020/8852124>.
- [61] GuangJun, L., Shah, N., Khan, H.U., Haq, A.U. (2020) 'Spam detection approach for secure mobile messages communication using machine learning algorithms', Security and Communication Networks, Special issue: Machine Learning and Applied Cryptography (MLAC), Vol. 2020, PP:1-6, <https://doi.org/10.1155/2020/>
- [62] Chen, L.H., Khan H.U., Hamami H. (2021), "An Empirical Study of Lenders' Perception of Chinese Online P2P Lending Platforms", *The Journal of Alternative Investments*, Forthcoming
- [63] Khan H.U. (2020), "Possible Linkage Between Internet Addiction, Socio-Demographic, And Behavioral Constructs: A Case Study Of Saudi Arabia And Bahrain Based Employees", *International Journal of Work Organization and Emotion*, Vol. 11, No. 1, pp:1-20, doi.org/10.1504/IJWOE.2020.109420.
- [64] Khan H.U., Christopher, A.A., Alomari, M. K. (2021), "Role Of E-Voting System for Void Of Errors In The Electoral Manipulations: A Case Study Of Nigeria", *International Journal of Business Information Systems*, Forthcoming.
- [65] Khan H.U., Aruya, J.A., Gill, A. Q. (2021), "Web 2.0 Technologies Adoption Barriers for External Contacts and Participation: A Case Study of Federal Establishment of Africa", *International Journal of Business Information Systems*, Forthcoming.
- [66] Khan H.U. (2020), "The Role Of Smac (Social Media, Mobility, Analytics, Cloud) For Students And Educators In Online Education", *Journal of Theoretical and Applied Information Technology*, Vol. 98, No. 6, pp: 915-934.
- [67] S. Nazir, S. Khan, H.U. Khan, S. Ali, I. García-Magariño, R. Atan, M. Nawaz. (2020) 'A comprehensive analysis of healthcare big data management, analytics and scientific programming', IEEE Access, Vol. 8., DOI 10.1109/ACCESS.2020.2995572.
- [66] Khan, H.U. and Saied, D.E.E.L., (2019) 'Pre and Post Implementation Of Integrated Health System: A Case Study Of Leading Gulf Country', *International Journal of Services and Operations Management*, Vol. 33. No. 1., pp. 113-133.
- [67] Peacock, D., & Khan H.U. (2019), "Effectiveness Of Social Media Sentiment Analysis Tools With The Support Of Emoticon/Emoji", 16th International Conference on Information Technology: New Generations, ITNG 2019, IEEE Conference, Las Vegas, Nevada, USA, April 1 - 03, 2019. (Conference Proceeding).

- [68] Khan H.U. & Peacock, D. (2019), "Possible effects of Emoticon and Emoji on Sentiment Analysis Web Services of Work Organizations", *International Journal of Work Organization and Emotion*, Vol 10, No. 2, pp:130:161.
- [69] Khan H.U., Hamami H.(2019), "Measuring Internet Addiction In Europe Based Knowledge Societies: A Case Study Of France", *Int. J. of Business Information Systems (IJBIS)*, Vol.32, No.2 pp.199:218 [Scopus Indexed, Inderscience].
- [70] Madhuri, M., Gill, A. Q., Khan, H. (2020). "IoT-enabled Smart Child Safety Digital System Architecture.", *IEEE 14 International Conference on Semantic Computing*, San Diego, USA, Febl 1 - 03, 2020. (Conference Proceeding)
- [71] Awan, M. A., Khan H.U. and Zhang, W. (2012) 'A comparative study on Online Service Quality Perception of two Major Regional Economies', *International Journal of e-Education, e-Business, e-Management and e-Learning(IJEEEE)*, Vol. 2, No.6, P.529-551.
- [72] Najmi, E., Hashmi, K., Malik, Z., Rezugui, A., Khan, H.U. (2015), "CAPRA: a comprehensive approach to product ranking using customer reviews", *Computing*, Vol. 97, No. 8, pp: 843-867.
- [73] Heang, J.F., and Khan, H.U. (2015), "The Role of Internet Marketing in the Development of Agricultural Industry: A Case Study of China", *Journal of Internet Commerce*, Vol. 14, Issue.1 , pp. 1-49.
- [74] Halabi A. E., Hachem A., Al-Akhrass L., Artail H., Khan H.U. (2014), "Identifying the linkability between Web servers for Enhanced Internet Computing", *17th IEEE Mediterranean Electrotechnical Conference MELECON 2014*, 13-16 April, Beirut, Lebanon. (Conference Proceeding)
- [75] Hassan, I. M., Khan, H. U. and Lalitha, M. (2016) 'Pedagogical Potentials of IEEE 802.11 WLAN to Nigerian Universities: A Case Study of the University of Uyo', *International Journal of Information and Education Technology*, Vol. 6, No. 4, pp. 256-261.
- [76] Khan, H.U. (2013) 'Use of e-learning tools to solve group work problems in higher education: A Case study of gulf countries', *The Advances in Computer Science: an International Journal*, Vol. 2, No. 3, pp.90-96.
- [77] Khan, H.U. (2016), "Possible effect of video lecture capture technology on the cognitive Empowerment of higher education students: a case study of gulf-based university", *International Journal of Innovation and Learning*, Vol.20, No. 1, pp. 68: 84.
- [78] Khan, H.U. (2013) 'Role of Computer Mediated Communication in Affect Empowerment and Performance Improvement', *IFRSA's International Journal of Computing*, Vol.3, No.3, P.165-171.
- [79]Khan, H.U. (2012) 'Computer Mediated Communication, Quality of Learning, and Performance', *Journal of GSTF Business Review*, Vol. 1, No. 3, pp. 81-88.
- [80]Khan, H.U., Artail, H., Malik, Z., Niazi, M.(2014a) 'Information Technology Adoption, possible challenges, and Framework of Supply Chain Management: A Case Study of a Leading Gulf Economy', *4th International Conference on International Conference on Engineering Technology and Technopreneurship*, Kuala Lumpur, Malaysia.
- [81] Khan, H.U., Ahmed, S., Abdollahian, M. (2013) 'Supply chain technology acceptance, adoption, and possible challenges: A case study of service organizations of Saudi Arabia', *10th International Conference on Information Technology: New Generations (ITNG 2013)*, Las Vegas, Nevada, USA.
- [82] Askoul, R., Khan, H.U. and Madhavi Lalitha, V.V. (2016) 'Cross-functional integration of marketing and information services in banking: a cross-industry comparison', *International Journal of Process Management and Benchmarking*, Vol. 6. No. 1. pp. 57-78.
- [83] Khan, H.U., Awan, M.A., Ho. H.C. (2014b), "How do Chinese and Saudi Customers Perceive Online Service Quality? A Comparative Study", *The Journal of Business Inquiry*, Vol. 13, No. 2.pp.142-157.
- [84] Khan, H.U., Omonaiye, J.F., and Madhavi Lalitha, V.V. (2017a) "Employees' perception as internal customers about online services: A case study of banking sector in Nigeria", *International Journal of Business Innovation and Research*, Vol.13, No.2, pp.181:202.
- [85] Brock, V. F. and Khan H.U. (2017b), "Are Enterprises Ready For Big Data Analytics? A Survey Based Approach", *Int. J. of Business Information Systems*, Vol.25, No.2, pp.256:277.
- [86] Das, A. and Khan, H.U. (2016) "Security behaviors of smartphone users", *Information and Computer Security, Information and Computer Security*, Vol. 24, No.1, pp. 116-134.

- [87] Awan, M.A., and Khan, H.U. (2016), "Status of Internet Addiction among College Students: A Case of South Korea", First American Academic Research Conference on Global Business, Economics, Finance and Social Sciences (AAR16 New York Conference), New York, USA, May 25- May 28, 2016.
- [88] Khan, H.U. and Fournier-Bonilla, S. D. (2016), "Technological Infrastructure Effects on Export Diversification: A Case Study of Qatar", Northeast Decision Sciences Institute Conference, Alexandria, Virginia, USA, March 31st – April 2nd, 2016.
- [89] Khan, H.U., Fournier-Bonilla, S. D., Jinugu, A., Madhavi Lalitha, V.V. (2016), "Possible Challenges of the Successful Implementation of CRM in the Service Sector: A Case Study of Saudi Arabia", Northeast Decision Sciences Institute Conference, Alexandria, Virginia, USA, March 31st – April 2nd, 2016. (Conference Proceeding).
- [90] Khan, H.U. and Alhusseini, A. (2015), "Optimized Web Design in the Saudi Culture", IEEE Science and Information Conference 2015, London, UK, July 28 - 30, 2015. pp.906-915 [Co-sponsored by Springer].
- [91] Khan, H.U., Uwemi, S. (2018a) "Possible Impact Of E-Commerce Strategies On The Utilization Of E-Commerce In Nigeria", International Journal of Business Innovation and Research, vol. 15, No. 2., Pp. 231-246.
- [92] Khan, H.U., Uwemi, S. (2018b) "What are e-commerce possible challenges in developing countries: a case study of Nigeria", International Journal of Business and Systems Research, Vol. 12, No. 4, pp: 454-486.
- [93] Uwemi, S., Khan, H.U. (2016), "E-commerce, Challenges, and Developing Countries", 2016 DSI Annual Meeting in Austin, TX, USA. November 19th – November 22nd, 2016.
- [94] Bashir, G. M., Khan, H.U (2016b), "Factors Affecting Learning Capacity Of Information Technology Concepts In A Classroom Environment Of Adult Learner", 15th International Conference on Information Technology Based Higher Education and Training (IEEE Conference), Istanbul, Turkey, September 8th – September 10, 2016.
- [95] Bashir, G. M., Khan, H.U., Fournier-Bonilla, S. D. (2016), "Applying Andragogy Theory to an Adult Multicultural Audience: How Cultural Factors Influence the Capacity for Adults to Learn Information Technology Concepts in a Classroom Environment", Northeast Decision Sciences Institute Conference, Alexandria, Virginia, USA, March 31st – April 2nd, 2016. (Conference Proceeding).
- [96] Hassan, I. M., Khan, H. U., Zaitun, R., Mardini, G. (2015), "Pedagogical Potentials of IEEE 802.11 WLAN to Higher Educational Institutions: A Case Study of Nigerian based University", IEEE 9th International Conference on Semantic Computing (IEEE ICSC 2015), Anaheim, CA, USA, Feb.7 - 9, 2015.
- [97] Omonaiye, J.F., Madhavi Lalitha., Khan, H.U., Signh, R., Fournier-Bonilla, S. D. (2015), "Ability and hurdle to provide Banking online services: A case study of banking employees in Nigeria", 2015 IEEE 2nd International Conference on Cyber Security and Cloud Computing, New York, USA, November 03 - 05, 2015. (Conference Proceeding).
- [98] Ejike, A. C. , Khan, H.U., Fournier-Bonilla, S. D. (2016), "Possible Impact of Mobile Banking on Traditional Banking: A Case Study of Nigeria", Northeast Decision Sciences Institute Conference, Alexandria, Virginia, USA, March 31st – April 2nd, 2016.
- [99] Uwemi, S., Khan, H.U., Fournier-Bonilla, S. D. (2016), "Challenges of E-Commerce in Developing Countries: Nigeria As Case Study", Northeast Decision Sciences Institute Conference, Alexandria, Virginia, USA, March 31st – April 2nd, 2016.
- [100] Ho, H. C., Awan, M. A., & Khan, H. U. (2016), "Luxury brands and corporate responsibility: A perspective on consumers' preferences", Journal of International Management Studies, 16(1), 77-81.
- [101] Smuts, R.G., Lalitha, M., Khan, H.U. (2017), "Change Management Guidelines That Address Barriers To Technology Adoption In An HEI Context", 7th IEEE International Advance Computing Conference, Hyderabad, India, January 5 – 7, 2017. (Conference Proceeding).
- [102] Bankole, O. A., Lalitha, M., Khan, H.U., Jinugu, A. (2017), "Information Technology In The Maritime Industry Past, Present And Future: Focus On Lng Carriers", 7th IEEE International Advance Computing Conference, Hyderabad, India, January 5 – 7, 2017.
- [103] Khan, H.U. and Ejike, A.C. (2017) "An assessment of the impact of mobile banking on traditional banking in Nigeria", Int. J. Business Excellence, Vol.11, No.4, pp.446:463.

**Tables and Figures**

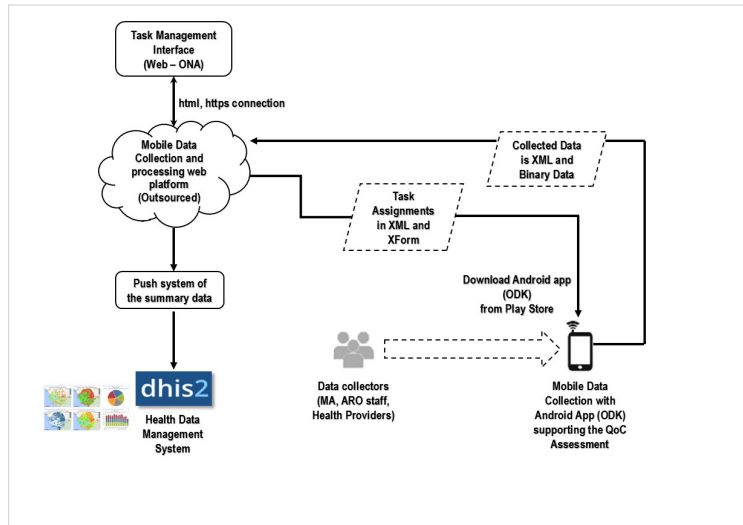


Figure 1. System Design Of The Mobile-Based Quality Of Care Assessment In The Two FHOK Facilities



Figure 2. Implementing Sites

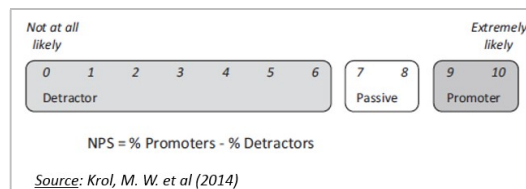


Figure 3. The Net Promoter Score scale

| FILE | HOME              | INSERT       | PAGE LAYOUT  | FORMULAS     | DATA       | REVIEW     | VIEW                                 | DEVELOPER |
|------|-------------------|--------------|--|--------------|------------|------------|--------------------------------------|-----------|
| A2   |                   |              |  |              |            |            |                                      |           |
| 1    | type              | name         | label:English  | hint:English | appearance | required   | calculation                          |           |
| 74   | end group         |              |  |              |            |            |                                      |           |
| 75   | end group         |              |  |              |            |            |                                      |           |
| 76   | begin group       | check2       | Check 2. Days open & opening times for different clients - 2 standards |              |            |            |                                      |           |
| 78   | select_one_yes_no | std011       | Opening days and hours convenient to most clients. (1/2)               |              |            | yes        |                                      |           |
| 79   | text              | std011c      | Additional comments:   |              |            |            |                                      |           |
| 80   | calculate         | std011na     |  |              |            |            | if(\$std011)=2,2,0)+0                |           |
| 81   | select_one_yes_no | std012       | Clearly displayed outside and inside the clinic. (2/2)                 |              |            | yes        |                                      |           |
| 82   | text              | std012c      | Additional comments:   |              |            |            |                                      |           |
| 83   | calculate         | std012na     |  |              |            |            | if(\$std012)=2,2,0)+0                |           |
| 84   | calculate         | scoreck02    |  |              |            |            | (\$std011)+(\$std012)-               |           |
| 85   | calculate         | nbck02       |  |              |            |            | (\$std011na)+(\$std012na))           |           |
| 86   | calculate         | denck02      |  |              |            |            | (\$std011na)+(\$std012na))div2       |           |
| 87   | calculate         | scoreck02    |  |              |            |            | 2-(\$nbck02)                         |           |
| 88   | calculate         | chk02        |  |              |            |            | round(\$scoreck02)div5(\$denck02)*10 |           |
| 89   | calculate         | chk02        |  |              |            |            | 0,2)                                 |           |
| 90   | calculate         | chk02        |  |              |            |            | if(\$scoreck02)=0,1,                 |           |
| 91   | calculate         | chk02        |  |              |            |            | if(\$scoreck02)=50,2,                |           |
| 92   | calculate         | chk02        |  |              |            |            | if(\$scoreck02)=100,3,0))            |           |
| 93   | begin group       | smry02       | SUMMARY FOR THE CHECK 2  |              |            | field-list |                                      |           |
| 94   | note              | displayk0a02 | The number of Non Application standards: \$(\$nbck02)                  |              |            |            |                                      |           |
| 95   | note              | displayk0b02 | The average of standards for this check is: \$(\$scoreck02)%           |              |            |            |                                      |           |
| 96   | note              | displayk0c02 | The check 2 is scored: \$(\$chk02)                                     |              |            |            |                                      |           |
| 97   | end group         |              |  |              |            |            |                                      |           |

Figure 4. Application Development Process In MS Excel

```

C:\Performance&Knowledge.Manager\OK\Paulin.TRA.2016\099\LABORATORY\021-QoC.TOOLS\IPFARO\ARO QoC tool\XLSForm\99 QoC Session 01.xml - Notepad++
File Edit Search View Encoding Language Settings Macro Run Plugins Window ?
index.html 99 QoC Session 01.xml
1 <?xml version="1.0" encoding="utf-8"?>
2 <h:html xmlns="http://www.w3.org/2002/xforms" xmlns:ev="http://www.w3.org/2001/xml-events" xmlns:h="http://
3 <h:head>
4 <h:title>99 QoC Session 01</h:title>
5 <model>
6 <text>
7 <translation lang="English">
8 <text id="/QoCtest01session_01/infosection:label">
9 <value>Welcoming information</value>
10 </text>
11 <text id="/QoCtest01session_01/identsection/local:label">
12 <value>In which City / Town / Village is the clinic?</value>
13 </text>
14 <text id="/QoCtest01session_01/check1/std07:hint">
15 <value>Please type:
16 - 1 for Yes
17 - 0 for No</value>
18 </text>
19 <text id="/QoCtest01session_01/check1/std06c:label">
20 <value>Additional comments:</value>
21 </text>
22 <text id="/QoCtest01session_01/check1/ck01c:label">
23 <value>Additional comments:</value>
24 </text>
25 <text id="/QoCtest01session_01/check1/std09:hint">
26 <value>Please type:
27 - 1 for Yes
28 - 0 for No</value>
29 </text>
30 <text id="/QoCtest01session_01/check1/std07:label">
31 <value>The facility has back up reliable source of power (generator or solar system).</value>
32 </text>
33 <text id="/QoCtest01session_01/identsection/note3:label">
34 <value>Please fill this information before to start the assessment process.</value>
35 </text>
36 <text id="/QoCtest01session_01/check1/std03:label">

```

Figure 5. Application Development Process Using XML Language



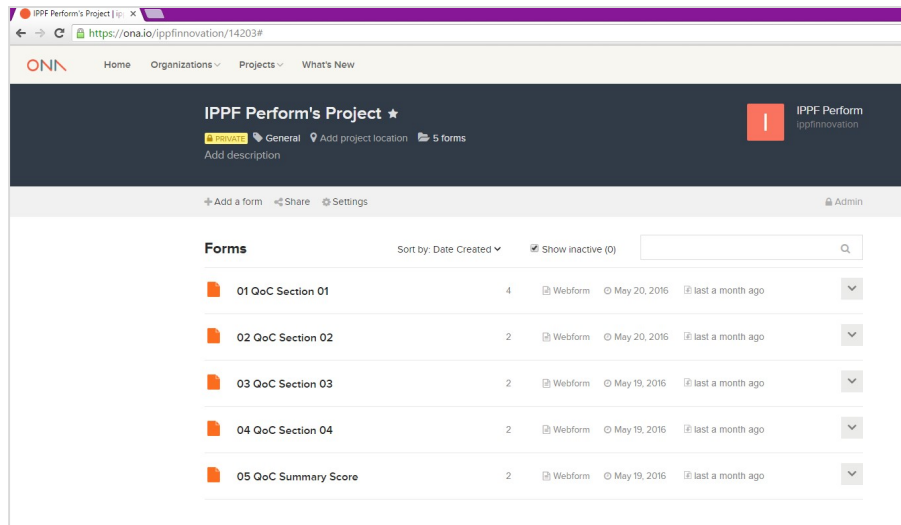


Figure 6. Uploaded Sections Of The Mobile Application

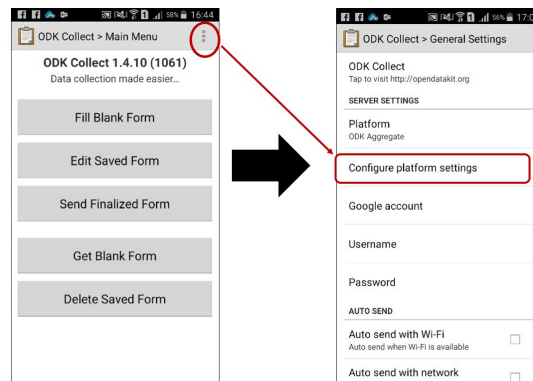


Figure 7. System Configuration In The Mobile Application

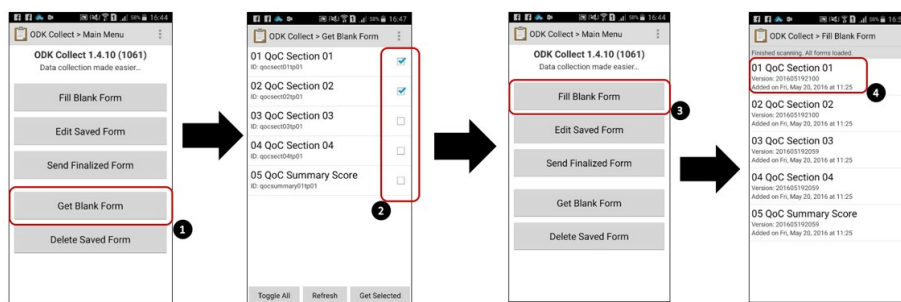


Figure 8. Downloading Process Of The Forms From The Web Platform

Table 2: Literature Review Table

| Factor                              | Reference  |
|-------------------------------------|--|
| IT artefact                         | [6] [8] [10] [33-45][103]                            |
| Low level of accountability         | [46-55] [61] [101][102]                              |
| Weak management of resources        | [56-60] [71][99][100]                                |
| Quality of care (QoC) in Healthcare | [61-70] [11] [91-98]                                 |
| Efforts in data collection          | [51] [47] [48] [26] [36] [76] [77] [78] [79]<br>[80] |
| Mobile-based data collection        | [71-75] [81] [82] [83] [84][85]                      |
| Low investment in health sector     | [86] [87] [88] [89] [90]                             |

Table 3: Scoring Guidance Of IPPF Quality Of Care Assessment Tool

| Check with 3 or more standards:  | Checks with 2 standards  | Checks with only one standard  |
|--|--|--|
| <ul style="list-style-type: none"> <li>• If 67% and above observed/met - Score as 3</li> <li>• if between 31% - 66% observed/met – Score as 2</li> <li>• if below 31% observed/met – Score as 1</li> </ul> | <ul style="list-style-type: none"> <li>• If both standards observed/met - Score as 3</li> <li>• if one standard observed/met – Score as 2</li> <li>• if none standard observed/met – Score as 1</li> </ul> | <ul style="list-style-type: none"> <li>• if standard fully observed/met – Score as 3</li> <li>• if standard partially observed/met – Score as 2</li> <li>• if none standard observed/met – Score as 1</li> </ul> |

Table-4: Repartition Of Participants To The Final Evaluation

|  | Case      | Control                                      |
|--|-----------|--|
| Kakamega                                       | 5         | Eldoret 5                                    |
| Meru   | 5         | Nakuru 5                                     |
| FHOK Headquarter                               | 5         | <b>Total participants in Control site 10</b> |
| IPPF ARO                                       | 5         |  |
| <b>Total participants in Case sites</b>        | <b>20</b> |  |
| <b>Total number of people interviewed = 30</b> |           |  |