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Exploring the State of Human-centred Design Practice in Software Development Companies: A Cross-Case Analysis of Three Nigerian Software Companies

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It is commonly believed that human-centred design (HCD) approach is very beneficial to interactive systems development. However, not much is known about the state of HCD practice in developing countries, especially the sub-Saharan Africa. This paper explores the state of HCD practice in three Nigerian software companies. We used the interview technique to explore two key issues. First, the perception of humans as a component of sociotechnical systems, and second, how HCD process is being approached in software companies. A cross-case analysis of the three companies was performed and the usability maturity model-human-centredness scale was used to determine the state of maturity of the three companies. The outcomes of this study reveal that HCD practice is currently at the least stage of maturity in the three companies and user involvement is not practiced in the right manner. The outcomes of the study suggest the need for reflective HCD practice and localizing human–computer interaction approaches to contexts.

RESEARCH HIGHLIGHTS

- Perception of humans in sociotechnical systems is good but not explicit.
- Aligning perception between actual users and super users.
- Market pressure could push some companies to embrace HCD.
- Implicit use of HCD techniques and low-level familiarity with usability and sociotechnical system theory should encourage the use of action research in companies.
- We provide some reflections regarding the state of HCD practice in three indigenous Nigerian software companies.

Keywords: human-centred design; usability maturity; sociotechnical system; cross-case analysis; Global South

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1. INTRODUCTION

One of the core design practices, which has emerged in the field of human–computer interaction (HCI) is human-centred design (HCD; Moreno *et al.*, 2013). Recently, HCD as a practice has continued to receive more attention from HCI and software engineering researchers. The concept of HCD has been used interchangeably with user-centred design (UCD) (Law and Lárusdóttir, 2015; Melton *et al.*, 2010), and

in this study, we would also use UCD and HCD interchangeably.

As our societies, people and computers have evolved so quickly and the part played by software systems is crucial, we cannot undermine the importance of factoring HCD into the software development processes (Bullinger *et al.*, 2002; Ogunyemi *et al.*, 2015). HCD as a design method has been around for over three decades (see (Norman and Draper, 1986)). The method has been largely promoted in the Global North (Chetty and Grinter, 2007). Nevertheless, the research community on HCI, HCD and usability seem not to be having any meaningful look at software development activities in Africa. The book on global usability (Douglas and Liu, 2011) revealed that little or nothing is known about the state of HCD and usability practice in African software development companies.

There are many benefits of incorporating HCD in the design and development of software systems. End users enjoy values such as human-centredness (Rasmussen, 2007), inclusiveness (Christensen, 2012; Dubois *et al.*, 2014; Fuchs, 2010), intuitiveness, (Bullinger *et al.*, 2002), accessibility (Haesen *et al.*, 2008), usability (Lanzilotti *et al.*, 2015), user experience (Lanzilotti *et al.*, 2015), vitality, independence and identity (Harper *et al.*, 2008). Software development companies achieve economic benefits such as improved sales and users' productivity (Ardito *et al.*, 2014), improved product usability and quality (Hussain *et al.*, 2009; Juristo *et al.*, 2007), reduction in development time, and cost (Lacerda and von Wangenheim, 2018), and end users' and customers' satisfaction (Hussain *et al.*, 2009; Maguire, 2001). Governments also benefit from quality software service delivery to the people (Axelsson *et al.*, 2010).

Although the benefits of HCD are quite visible, many software development companies still produce software systems and services without taking human cognitive abilities into consideration (Bullinger *et al.*, 2002). Some development approaches still perceive the human users as a component that should be trained to be able to interact with software systems (Oviatt, 2006). Quite often software reliability, for instance, may be error-prone and misleading (Shneiderman and Plaisant, 2005), thereby increasing cognitive workload for the human user (Bødker, 2006). Many software development activities in various companies seem to be clearly neglecting 'the ways we perceive and handle information, go about our work and life, create and maintain social relations, and use our cultural context and relate to our environment' (Lamas *et al.*, 2013, p.1).

This paper presents a cross-case analysis of HCD practice in three Nigerian software development companies. Our rationale is that although previous studies done by Aregbesola *et al.* (2011) and Soriyan and Heeks (2004) indicate that the process maturity of software development in many Nigerian software companies is low, studies have shown that software quality assessments in many software development companies do not quite often include the aspects of usability and accessibility (see e.g. (Boivie *et al.*, 2003; García-Mireles *et al.*, 2015)). Therefore, there is a need to conduct usability maturity assessments in software development companies. According to Jokela *et al.* (2006), one way companies can improve their UCD process and product development is by conducting usability capability maturity assessments to determine where they stand and figure out what they need to do next. Another reason for usability assessment is that many companies only prioritize usability at the software maintenance stage and this is not cost effective (Folmer and Bosch, 2004).

Nigeria is a West African country and the most populous country in Africa[1] (~186 million in 2016) and is the largest economy in Africa[2] (2017 World Bank report). There are about 250 ethnic groups in Nigeria and over 500 local languages. However, English is the official language. Adult literacy rate in Nigeria was 59.6% in 2014 and 8.5% of Nigeria residents were connected to the Internet also in 2014. Internet bandwidth per user was 1000 bit/s. Wireless broadband penetration was boosted by 10% in 2013 as a result of participation of telecommunication firms such as MTN.[3]

We provide in-depth analysis and overview of case studies of three Nigerian software development companies. We describe software development practices in three companies in relation to sociotechnical systems development and used the Usability Maturity Model-Human-centredness Scale (UMM-HCS) described by Earthy (1998) to analyse the state of HCD practice in three Nigerian software development companies. The aim was to identify and present critical issues for the promotion of HCD practice in software development companies in developing countries, especially those found in the sub-Saharan Africa where HCI practices are still in their infancy. This study would be beneficial to HCI and software engineering researchers and practitioners, aiming to promote HCD practice in developing countries. The rationale for choosing the UMM-HCS is because of its appropriateness to our need and to enhance the effectiveness of existing models through empirical use (Jokela *et al.*, 2006; Wendler, 2012). One of the challenges of existing usability capability maturity models is their low empirical level and validation (Jokela *et al.*, 2006; Lacerda and von Wangenheim, 2018).

The basic questions we have raised in order to explore the state of HCD in the selected Nigerian software development companies are stated thus:

(i) How are humans perceived in the development of software systems?
(ii) Are software development companies translating their perceptions of human in software systems development by involving the actual end users?

[1] http://databank.worldbank.org/data/download/POP.pdf
[2] http://databank.worldbank.org/data/download/GDP.pdf
[3] According to the ITU 2015 report accessed at www.itu.int/en/ITUD/Statistics/Documents/publications/misr2015/MISR2015-w5.pdf

(iii) How is HCD being practised in Nigerian indigenous software development companies?

The rest of this study is organized as follows. The next section provides a brief theoretical background of overviews of sociotechnical systems, HCD and the usability maturity model. Section 3 describes our research methodology. Section 4 presents our analysis, whilst Section 5 discusses the answers to our research questions and also provides some reflections for research and practice. Finally, we conclude and present the direction of our further research.

2. RELEVANT LITERATURE

In approaching this study, we examined the literature on what could be the important things to know regarding the design of software systems for human use. Today, interaction of users with computing devices has gone beyond the aspect of usability. User experience has become a criticality for designers and developers of interactive systems. In order to articulate these notions, this section provides a brief overview of sociotechnical systems, with the understanding that human is a core component and software systems are sociotechnical systems. Next, we take a brief examination of the HCD and specifically focusing on the context of HCD in the global south, and finally, we provide an overview of the UMM-HCS—a model that was developed to help assess the state of maturity of software companies with regard to HCD practice.

2.1. Sociotechnical systems development

Sociotechnical systems are a synergy of two systems—technical systems and social systems (Whitworth and Ahmad, 2014) and require the co-design of the two (Baxter and Sommerville, 2011; Fischer and Herrmann, 2011). Fischer and Herrmann (2011) viewed sociotechnical systems as 'the systematic integration of two kinds of phenomena that have very diverging, partially contradictive characteristics' (p.3). The technical systems are deterministic, pre-planned and meant to serve the users' needs (Fischer and Herrmann, 2011). Social systems, on the other hand, are nondeterministic, cannot be pre-planned and serve just their own needs (Fischer and Herrmann, 2011). For these reasons, the design of sociotechnical systems is always very challenging (Carayon, 2006).

According to Whitworth and Ahmad (2014), sociotechnical systems evolved from the era of hardware with the works at IBM in the 1970s. In the 1980s, hardware was combined with software and this became information technology (IT). Microsoft became a leading software house during the period. The 1990s saw the launch of the era of personal computers (PCs) and the Internet. However, due to the pervasive nature of PCs and the Internet, there was an exponential growth of the number of people interacting with computing devices. This paved the way into the 2000s when computing interaction became more of social interactions. Thus said, sociotechnical systems are a combination of hardware, software, people, organization and a social environment (Baxter and Sommerville, 2011; Fischer and Herrmann, 2011).

Software systems are a very good example of a sociotechnical system (Bourimi *et al.*, 2010). A social environment could be an online community facilitated by software systems such as Facebook, YouTube and Wikipedia; or a workplace where office applications such as word processor are used. Whitworth and Ahmad (2014) posit, 'adding people to the computing equation meant that getting (a) technology to work was only half the problem—the other half was getting people to use it' (p.10). According to Bourimi *et al.* (2010), sociotechnical systems are associated with complex issues, which are majorly channelled through, for example, the user interface and for this reason, the HCI and computer-supported cooperative work (CSCW) fields give full focus to human aspects of interactive systems development in collaborative environments. This is the reason why also many development activities follow user-centred approach (Bourimi *et al.*, 2010). Thus in order to achieve an effective design of sociotechnical systems, wide-range perspectives from fields such as sociology, psychology, ergonomics, computer science and engineering should be applied (Whitworth and Ahmad, 2014).

From the backgrounds presented, it can be argued that it is not enough to view software development from usability perspective, which appears to be a common denominator for all systems designers and developers. Usability of a system is viewed from effectiveness, efficiency and user satisfaction and although the involvement of the user from the beginning of the development is considered important, the perception of just being a system tester is quite worrisome (Dillon, 2000). The value of usability is diminished by limiting focus to the user instead of a group, and a task instead of the workplace, according to sociotechnical systems theory (STST) (Dillon, 2000; Whitworth and Ahmad, 2014). Another major problem with usability is testing. Usability testing seems to be about whether people can use a tool rather than whether people will use a tool (Dillon, 2000). STST perspectives when combined with usability engineering and UCD principles enhance systems development. One of the principles of STST is that the work system is the major design unit. Therefore, technology should give support to a work group instead of an individual user or task. The major challenge with STST principles, however, is that they are theoretical constructs and are difficult to measure (Bourimi *et al.*, 2010; Dillon, 2000; Thakker *et al.*, 2011). For this reason, Dillon (2000) recommended a synergy of usability engineering and STST principles to designing a system. For example, STST can be applied from the beginning to give insights into how the operational criteria for measuring the system-effectiveness, efficiency and satisfaction can be set such that the needs of the actual work context where the system will be used are clearly and successfully

conveyed. Dillon (2000) proposed the involvement of the system stakeholders to determine satisfaction rather than just the actual users. In a recent study, Chilana *et al.* (2015) corroborated on the need to involve stakeholders when they share their experience with a user-centred innovation and argue that too much focus on the end users make the critical needs of the adopting company obscure and also ignore the perspectives of other stakeholders.

Whilst the design of sociotechnical systems can be very challenging (Bourimi *et al.*, 2010; Carayon, 2006) due to human factor issues such as culture (Carayon, 2006), and project stakeholder's needs (Baxter and Sommerville, 2011; Bourimi *et al.*, 2010) among others; HCD has been identified as one of the prominent methods to make the design of sociotechnical systems less challenging (Bannon, 2011; Giacomin, 2014). Specifically, one of the key arguments is to reimagine and act out a better world (Bannon, 2011). The author exemplified this argument by proposing 'exploration of new forms of living with and through technologies that give primacy to human actors, their values, and their activities' (Bannon, 2011, p.50). Similarly, it is argued that 'interactions and meanings are the result of a process of communication and learning which cannot be fully anticipated with the original physical, perceptual and cognitive objectives of the design' (Giacomin, 2014, p.609). For this reason, HCD seeks to empower the intended product users by allowing them to lead the design process by raising questions, sharing insights and describing their activities so the solution designer is able to craft the intended solution successfully (Giacomin, 2014). The following subsection provides more insight into HCD.

2.2. Human-centred design

HCD is 'an approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques' ((ISO, 2010a) copied from (Giacomin, 2012, p.2)). HCD brings together applied perspectives from varying fields such as ergonomics, computer science and artificial intelligence to produce interactive systems for human use (Giacomin, 2012; Kesseler and Knapen, 2006; Rasmussen, 2007). There are six principles for following HCD according to the ISO 9241-210 (ISO, 2010a) framework:

(i) There is explicit understanding of users, tasks and environments.
(ii) There is involvement of users throughout design and development phases.
(iii) The design is driven and refined by user-centred evaluation.
(iv) The design is iterative.
(v) The design holistically addresses user experience.
(vi) There is an application of multidisciplinary skills and perspectives to the design process.

The broad principles specified in ISO 9241-210 is exemplified by a model proposed by Giacomin (2012) presented in Fig. 1.

The HCD pyramid in Fig. 1 depicts a set of questions and answers, which cover a wide spectrum of the physical interaction to the metaphysical, of a user with an interactive system. The model has at its base a quantum of concerns, which address basic scientific understanding of 'human physical, perceptual, cognitive and emotional characteristics' (Giacomin, 2012, p.6). There are sets of more complex interactive and sociological concerns towards the peak of the pyramid. There is a concern based on the metaphysical, at the peak of the pyramid, for what offers a meaning to the individual interacting with a system.

According to Giacomin (2012), a design that could answer the questions and curiosities found towards the top of the pyramid is capable of providing many affordances to the user and fixing deeply into their minds and everyday lives. For instance, an interactive system that gives the user a new meaning to life could as well provide them with 'ample opportunities for commercial success and (for) brand development' (Giacomin, 2012, p.6). Thus, the HCD is more important than just offering a usability benefit to a system.

Today, more software development companies are recognizing the criticality of HCD to the success of their products (Giacomin, 2012; Maguire, 2001). However, the introduction of HCD to software development companies is not without certain challenges. Kuutti *et al.* (1998) noted that there are certain conflicts and misunderstanding experienced when introducing HCD to a company. These challenges include but are not limited to:

- A low level of process maturity (Earthy *et al.*, 2001).
- Value propositions from business perspectives (many companies prefer the 'technology-push' orientation to HCD) (Giacomin, 2012).

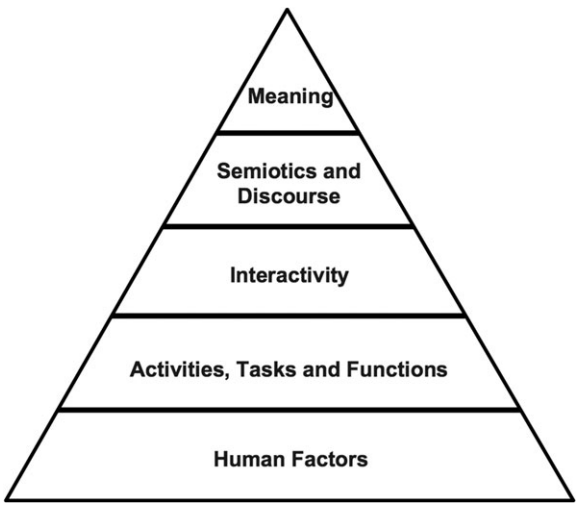

FIGURE 1. HCD pyramid. Reproduced/what is HCD? P/&D design, 2012 adapted with authorization of author.

- The mindset (technical issues, programming and functionality of a system) of the software developers (Ardito *et al.*, 2014).

Kuutti *et al.* (1998) suggested that companies should focus on their awareness, attitude, skills, empowerment and resources as ways to overcome the stated challenges.

2.2.1. *HCD practice and software development in the Global South*

There is no universal approach to software development and HCI/HCD practice from one context to another. Most of the approaches to software development and HCI/HCD are from the West. There are known challenges when introducing these 'Western' approaches to other contexts such as the Global South. Some of the known challenges, which limit HCD in the Global South include but are not limited to lack of IT knowledge (Molapo and Marsden, 2013), lack of awareness (Hussein *et al.*, 2011) and lack of fit (Joshi and Gupta, 2011).

Liu (2014) reviewed UX trends in Asia and revealed that countries such as India, China, South Korea and Japan experienced different trends over time. In China, there exist local chapters of the ACM SIGCHI and UXPA that provide support for advancing UX activities. The local IT market is quite competitive. Multinational companies such as IBM, Microsoft and Nokia create stiff competition for local development companies and as a result, indigenous companies such as Lenovo, Tencent, Baidu and Huawei have been able to advance their HCI/UX practice over the years. UX practice has also gained recognition among academics. However, there are no academic resources dedicated to usability or HCI. Similarly, there is UX focus on consumer electronic products and online services but less UX focus on customized software application (Liu, 2014).

Citing the work of Joshi and Gupta (2011); Liu (2014) revealed that the fast growth of mobile technologies has contributed immensely to ICT use in India. Moreover, use of the Internet and interactive systems also contributed to demand for HCI and usability expertise in the local market. Therefore, UX expertise has increased in demand in Indian IT companies. HCI is also gaining recognition in the universities and some companies provide support by training professionals to do HCI works. Government has also recently been promoting HCI research by providing funding support. However, some imported usability methods are not suitable for local use, thereby creating a barrier to UX acceptance as a profession. HCI university education is also lacking for IT/computer science students.

Liu (2014) revealed that Japan is well known for its advanced ICT industry. Usability engineering gained acceptance among usability professionals with the introduction of the ISO 13 407:1999 principles for HCD. There is the Human-Centred Design Network (a public organization) that oversees usability activities in Japan. However, usability works are only by industry practitioners and not academics. Furthermore, only few universities offer usability programmes.

South Africa engages in both offshore and onshore software development where a local company outsources its software development to other countries such as India (Tanner, 2009). Software outsourcing is also a growing trend in the Chinese software development industry (Ji *et al.*, 2008).

Nigeria is still in the formative stage regarding HCI and software development. HCI education has just been recently introduced into very few Nigerian universities. The major focus of the HCI curriculum is on usability engineering and is not detailed. Although a computer society exists with its branches across the country, there is no special interest HCI group. There is a lack of cooperation between academia and the software industry and as a result, global standards are not being followed (Akinola *et al.*, 2009). Majority of the indigenous software companies are into customization of foreign software for local customers (Soriyan and Heeks, 2004). Only few software companies engage in custom software development. The Nigerian software policy was drafted in 2013 but not yet fully implemented and enforced. Generally, the ICT industry in Nigeria is not comparable to other developing countries such as China, India, Malaysia, Taiwan, Hong Kong and South Korea. Similarly, unlike China, the presence of multinational companies such as Microsoft and IBM has not contributed to the local market in Nigeria. Rather, these multinationals use Nigeria as a destination for selling their products and not for developing software solutions (Momodu *et al.*, 2007).

2.3. Usability maturity model and human-centredness

There are a few usability maturity models, which have been developed in the field of HCI. Generally speaking, models are developed for different purposes, therefore, their choice are motivated by the purpose for which they have been developed (de Bruin *et al.*, 2005). de Bruin *et al.* (2005) identified descriptive, comparative and prescriptive purposes for developing a maturity model. Similarly, maturity models have different goals for their applications, and these goals can generally be for recommending areas for improvement in a process or certifying products. Jokela (2004b) identified four purposes in their study. These include creating awareness, kick-starting usability improvement programme, monitoring progress and drawing curiosity. However, only few usability models are validated (Lacerda and von Wangenheim, 2018). A lack of validation limits the use of many of these models, especially those recently developed. A recent systematic literature survey by Lacerda and von Wangenheim (2018) indicates that majority of the existing usability maturity models are on consolidated software process capability maturity models (SPCMM), such as capability maturity model integration (CMMI) and ISO/IEC 15 504. Moreover, only five of these existing models of which the UMM-HCS is included offer descriptive process as reference models.

The UMM-HCS by Earthy (1998) is one of the scales used to assess the level of HCD practices in software development companies (Smith *et al.*, 2007). The study by Lacerda and von Wangenheim (2018) also revealed that the UMM-HCS is among the very few usability maturity models that offer detailed procedure planning, selecting stakeholders, collecting data, rating and calculating the process capability/maturity level. Other models listed among these few usability maturity models are presented in the works of Earthy (1999), ISO (2010b), Jokela (2001) and Salah (2013). The models proposed by Earthy (1998) and Earthy (1999) are similar. Both models are tailored towards HCD practice and based on ISO 13 407 (ISO, 1999). The major difference between Earthy (1999) and Earthy (1998) is that the former defines the process for assessing 'the degree of capability reached by an organisation in its ability to perform human- centred design activities' (Earthy, 1999, p.7), while the latter defines the process for determining the level of an organization's maturity to have the capability to conduct HCD tasks. The model by Jokela (2001) is a process model for defining usability performance in project and does not focus on internal process unlike Earthy (1999) and Earthy (1998). The model described by Jokela (2001) was later developed and published by Jokela (2004a). Salah (2013) explored the possibility of usability maturity in agile-user-centred design integration. ISO (2010b) is a process model for assessing the maturity of an organization to perform human-centred system development tasks.

Looking at the existing usability maturity models, other models that could fit our goal in this study, include Earthy (1999), ISO (2010b), Nielsen's Corporate UX maturity model[4] and STRATUS (Kieffer and Vanderdonckt, 2016). Generally, ISO models are not freely available and this limits their use for conducting academic research. Nielsen's Corporate UX maturity model is a descriptive model, which describes eight stages of maturity and assocuated attributes, which an organization can exhibit. Nielsen's Corporate UX maturity model does not provide guidelines with which an organization can be assessed based on the defined attributes. Similarly, STRATUS does not provide procedure for planning, selecting stakeholders, collecting data, rating and calculating the process capability/maturity level (Lacerda and von Wangenheim, 2018). Our goal was to describe to what extent the process of a software development company is human-centred and not just the overall quality of the product. Although some of the existing models fit our goal, the UMM-HCS offered better support to achieving our goal.

HCI/HCD scholars have successfully used the UMM-HCS. The primary purpose for using the UMM-HCS seems to be descriptive. Liu (2002) applied the UMM-HCS to describe to what extent the process of five Chinese IT enterprises was human-centred. Similarly, Smith *et al.* (2007) used the UMM-HCS to investigate the state of human-centred developments in Indian software/IT development companies. Ashley and Desmond (2009) applied the UMM-HCS to describe a case of company that transited from the maturity level of *Implemented* to *Integrated* based on planning, designing and testing an enterprise application suite. In a recent study, Marchiori *et al.* (2012) used the UMM-HCS and a conjectural model—eTourisim Communication Maturity Model to determine the state of maturity of seven Italian and Swiss local destination management organizations. Table 1 presents an overview of the UMM[5].

TABLE 1. The usability maturity model.

ID	Title
Level X	**Unrecognized**
	(no indicators)
Level A	**Recognized**
A1	Problem recognition attribute
A2	Problem processes attribute
Level B	**Considered**
B.1	Quality in use awareness attribute
B.2	User focus attribute
Level C	**Implemented**
C.1	User involvement attribute
C.2	Human factors technology attribute
C.3	Human factors skills attribute
Level D	**Integrated**
D.1	Integration attribute
D.2	Improvement attribute
D.3	Iteration attribute
Level E	**Institutionalized**
E.1	Human-centered leadership attribute
E.2	Organizational human-centredness attribute

The UMM has a set of ordered scales on attitude, technology and management practices and aims to help organizations mature towards taking up human-centred approach to developing interactive systems. The UMM is a qualitative descriptive tool, which also has checklists that can be used to assess organizations' human-centredness. A company, which shows an outright lack of interest in usability, is classified as *Unrecognized*. Such a company might be considering investments in HCD practice as a waste of time and loss of investments. A company transits to the level of *Recognized* when it exhibits sincere but unsystematic attempts to prioritize usability concerns in its product development. A company moves to the level of *Considered* when it begins to make strategic financial investments by hiring HCI experts on projects or engaging in a purposeful organization of training for its staff (Smith *et al.*, 2007). Such a company no longer relies on 'good practice' or 'engineering judgement' (Earthy, 1998,

[4]Accessed at www.nngroup.com/articles/usability-maturity-stages-1-4 and www.nngroup.com/articles/usability-maturity-stages-5-8

[5]Reproduced/usability maturity model: human-centredness scale, INUSE Project Deliverable D5, 1998 with permission from Lloyd's Register.

p.11). A company at the *Implemented* level should have made a major cultural change. Such a company has been able to make user involvement a strong priority in software projects. The company has realized the need to apply HCI skills on a regular basis and can develop usable products. At the *Integrated level*, a company's HCD activities have become mainstream and routine for all projects (Smith *et al.*, 2007). Finally, at the *Institutionalized* level, a company has become a leader in human-centred developments. Multidisciplinary culture now drives business focus and systems developments. The rating scale and how organizations can transit from one level of maturity to another is presented in Table 2[6].

The rating procedure is presented in Section 4 and the interview recording form as excerpted from Earthy (1998) is in Appendix 1, available in the supplementary material. The full details of the tool are described by Earthy (1998).

TABLE 2. Ratings in the usability maturity model.

Scale	Process attributes	Rating
Level A	Problem recognition	Fully or largely
	Performed processes	Fully or largely
Level B	Problem recognition	Fully
	Performed processes	Fully
	Quality in use awareness	Fully or largely
	User focus	Fully or largely
Level C	Problem recognition	Fully
	Performed processes	Fully
	Quality in use awareness	Fully
	User focus	Fully
	User involvement	Fully or largely
	Human factors technology	Fully or largely
	Human factors skills	Fully or largely
Level D	Problem recognition	Fully
	Performed processes	Fully
	Quality in use awareness	Fully
	User focus	Fully
	User involvement	Fully
	Human factors technology	Fully
	Human factors skills	Fully
	Integration	Fully or largely
	Improvement	Fully or largely
	Iteration	Fully or largely
Level E	Problem recognition	Fully
	Performed processes	Fully
	Quality in use awareness	Fully
	User focus	Fully
	User involvement	Fully
	Human factors technology	Fully
	Human factors skills	Fully
	Integration	Fully
	Improvement	Fully
	Iteration	Fully
	Human-centred leadership	Fully or largely
	Organizational human-centredness	Fully or largely

3. METHODOLOGY

The exploratory case study approach (Tellis, 1997) was used in this study and the interview technique was selected as described by Yin (1994). The exploratory case study approach was used since no hypothesis was formulated. A similar approach has been used by Kuusinen *et al.* (2012).

3.1. Participants

Interviews were conducted with 10 key members of the development/project teams across three companies located in Lagos, Nigeria. The individuals interviewed were chief technical officers, project managers, UI designers, quality assurance specialist, programmer, human resource manager and the ICT infrastructure and network support specialist.

3.2. Procedure

The focus of the interviews, on the one hand, was to understand the working relationship pattern of the companies, communication and the processes for software development. On the other hand, the focus was to gain insights into the perception of the human component of sociotechnical systems and understand how this perception is being applied to software development processes, and how the HCD principles described in the ISO 9241-210 are being approached. Since there is no prior knowledge whether these companies have standard HCI teams and practice in place, the analysis of the interviews was based on the affinity diagramming method described by Beyer and Holtzblatt (1998). Finally, we applied the cross-case analysis described by Seaman (1999). We treated each of our focuses as a case. We compared across the cases to determine the differences and similarities in how practitioners perceive human as components of sociotechnical systems as well as attitude towards HCD.

We selected two small and a medium software development companies located in Lagos, Southwest Nigeria using the snowball sampling technique. Our rationale is that as indicated by previous studies, there is a low-profile software development practice in Nigeria (Aregbesola *et al.*, 2011; Egbokhare, 2014; Soriyan and Heeks, 2004). Furthermore, most of the development companies are located in Lagos, which is a major economic hub in Nigeria. The three companies were found through some personal networking and two of

[6]Reproduced/usability maturity model: human-centredness scale, INUSE Project Deliverable D5, 1998 with permission from Lloyd's Register.

the companies are involved with custom software development and one is involved with off-the-shelf product development.

The profile of the companies and interviewees are provided in Table 3. Each interview lasted a minimum of 45 min and the questions asked were based on the following criteria:

- Recognition of usability problem.
- Performance of HCD from sociotechnical systems development point of view.
- Quality in use awareness and user focus.
- User involvement.

The questions were asked in a structured manner that tied with the process and management attributes described in the UMM-HCS. The questions were asked in such a way as to allow the interviewees describe the state of their HCD practice as is. The questions were drawn in line with the four criteria listed. For example, some of the questions are as follows:

- Do software projects fail because end users are not involved? (When asked one of the project managers about this question, we got an insight that end users are perceived differently. For example, in the medium company, IT managers or top officers who are involved with project sign-offs in customers' organizations are perceived as the end users. The day-to-day users of the system are simply perceived as 'organizational users' and these are not involved in the development process, thereby undermining one of the basic principles for HCD according to ISO 9214-210).
- How do you elicit user requirements?
- Do you consider the experience end users get before, during and after they interact with your products?
- How do you elicit users' feedbacks and what do you do with these feedbacks?
- How do you assign responsibilities to project team members?
- How much familiar are project team members with HCI concepts such as values?
- What is your company's approach to designing for user values?
- How are humans being perceived in sociotechnical systems development?

The questions were asked sometimes sequentially. For example, the question on usability problem recognition was motivated from the need to involve actual users in projects. Consequently, the question led to asking about perception of humans in sociotechnical systems and from this point, structured questions were asked based on the ISO 9241-210 framework for HCD practice.

3.3. Materials

All the interviews were recorded in audio format and later transcribed and analysed using the UMM-HCS guideline. The interviews were transcribed using the *EasyTranscribe* software. The ratings were recorded in the assessment form extracted from Earthy (1998) (see Appendix 1, available in the supplementary material).

4. ANALYSIS

The analysis of the three companies is presented in three parts. The three subsections were categorized in line with the three questions raised for the study. The analysis is descriptive. The first part is about how the companies approach software development from sociotechnical system context with humans in view. The second part describes software

TABLE 3. Profiles of the interviewees and their companies.

Company size	Alias	Company's years of existence	Development type	Interviewees' role	Code	Interviewees' educational background
Medium (150–250 staff)	Gamma	More than 10 years	Off-the-shelf (Software as a Service (SaaS))	Chief technical officer	P1	Postgraduate
				Project manager	P2	MSc
				Head, human resources	P3	MBA
				Quality assurance specialist	P4	BSc
				Enterprise security specialist	P5	BEng
Very small (10–0 staff)	Delta	More than 10 years	Custom development	Chief technical officer	P6	BSc
				User interface designer	P7	HND
Very small (10–20 staff)	Omega	More than 10 years	Custom development	Project manager	P8	OND
				User interface designer	P9	OND
				Programmer	P10	BSc

development processes in the three companies and whether the processes reflect a human-centred approach. The third part is about using the UMM-HCS to analyse the level of maturity of the companies in terms of human-centred development. It appears, as can be seen in Table 3 that the companies have high profile staff in their development/project teams. All the interviewees have relevant educational background and vast industry experience. The full profiles of interviewees and their companies are presented in Table 3.

4.1. Software developments from sociotechnical systems approach

The motivation for development in each company is unique. Two of the companies tend to be innovative by indicating they want to be best at what they do (lead in the local market) or creative. For example, Gamma indicated:

> 'One key reason why we settled for off-the shelf software applications or software products is one, because we don't want what I will describe as distraction. We just rather have ourselves focused… That will give us the opportunity to innovate, to be more creative, to advance our product pretty well … based on market intelligence.' (P1)

On their part, Omega feels off-the-shelf development does not allow a company to be creative.

> 'There is no way you want quality that you will be in a hurry because off the shelf products are readily available. We also think off the shelf doesn't allow you to be creative enough.' (P8)

However, Delta has a different perspective and believes more in being flexible. The rationale for this flexibility is for survival.

> 'Firstly, to be able to determine survival mode you want a situation whereby irrespective of if jobs didn't come you are still able to run your business.' (P6)

When reminded competitors want to be innovative, the interviewee (P6) provided further explanations.

> 'There is absolutely no way you wont be innovative in the way the product is, the way the market perceives your value for them to be able to patronize you.' (P6)

Overall, each company has their unique motivation for the kind of development they have chosen. From the explanations provided by the companies, market intelligence appears to be a strong driving factor to be innovative or creative. The value being prioritized in product development varies per project. The major value the companies try to offer is in solving the customer's problem. The value offered is in making the software products bring added economic advantage and increased productivity to the customer organization.

> 'Most of the time, the clients have a problem they want to solve. I think the value is in solving the problem. In solving the problem you have added value.' (P6)

> 'We always try to surpass clients' expectations by giving them more values than they wanted.' (P10)

> 'There would always be a need for off-the shelf application; so long they are well-written, so long as they actually solve the customer's needs.' (P1)

Regarding solving problems for clients, we wanted to understand the perspectives of the companies to sociotechnical system development. The responses of the companies tend towards the same—human is the centre of the development focus. Only Gamma appears to be somewhat familiar with the term 'sociotechnical system'. The interviewer had to explain what this term means in order to help other companies understand. The fundamental insight is that practitioners do not explicitly know many or some theoretical terms.

> 'Usually, humans are at the centre, the products are meant to drive efficiency, quick turnaround time depending on the product in question. So there is absolutely no way you can talk about any of our software product without bringing human at the centre.' (P1)

> 'Our default perception is that the human is a complete novice—the person that wants to use the system we built.' (P6)

> 'The system is created from human-centred perspective. We perceive the user as one that is not so literate. With this we try to make the system as simple as possible such that the user does not need to come back. We perceive that the user may not be tech savvy.' (P9).

> 'Having the user in mind for every development. Looking at things from different ways. Putting different scenarios into things. We need to find a balance if a young man and an elderly person have to use the solution.' (P10)

From these quotes, we can see that humans are perceived as an integral component of software systems and user experience is considered very important. The three companies appear to do the thinking for majority of the customers.

> 'There would be a market for it and most people prefer actually going for off-the-shelf application, so long as they have the assurance and guarantee that the application would solve or meet their requirements.' (P1)

> 'We have innate market knowledge of this place. The way you build the same product for a more advanced nation is different from how it is in Nigeria. The way we develop our applications is to make sure that some things are clear to your face (visible), you can't miss it' (P6)

In many cases, the companies do the design thinking for customers and the goal of the product is to give the user good experience. This is the way the companies bring their perceptions into implementing socio-technical system design.

> 'One of the things we strive to do is to ensure that humans usually have a very good experience working with these software products.' (P1)

> 'We have a perception that at least we have interacted with some software and we feel that it is complex for us and if it is complex for us that have the technical background, then it is complex for non-technical people.' (P6)

One of the ways in which Omega designs for user experience is in navigation of the system.

> 'Navigation is topmost; the user must not be lost. While the user is interacting with the application, the process he is supposed to take, maybe 3 or 4 steps, we tend to simplify it. For example, a user want to complete a registration, we try to simplify the process such that it is not elaborate.' (P9)

Similarly, both Gamma and Delta indicate priotize aesthetics and intuitiveness in systems design.

> 'First thing is that user-friendly approach. We try to design systems that user find very intuitive to use. Meaning when you are presented with that interface, you don't necessarily require a lot of training.' (P4)

> 'Just taking you directly to where we want you to be even though we can still make it aesthetically fine, there are menus, there are dropdowns, … just I want to go straight to what I need and here because of our challenge, or of our market, we try to design along those lines to make it easy, and that is what they call user experience here.' (P6).

From the foregoing, it can be assumed the three companies have the right perception to make systems development human-centred. The companies study the market, do the design thinking to come up with solutions customers would need. Usually, customers are not involved in many cases because they feel development companies have the requisite skills and competence. In few cases, customers provide the basic requirements for the system being built and still rely on the competence of the developer to deliver a very innovative product. In the following section, we provide further insights into how development is being done in each of the three companies.

The overview of the companies' perceptions and approach to sociotechnical systems design is described in Table 4.

The three companies perceived human to be at the centre of interactions with software systems, and the software systems are to drive efficiency and quick turnaround time. To achieve this goal, the companies indicate they approach the design of software systems with the users in mind so they can have a very good experience. To ensure the design of intuitive software, the companies indicate they focus on labels and positioning of fields, among other things. Their overall goal is to build user-friendly solutions, which do not require the user to undergo an elaborate training.

4.2. Product development processes

The approach described by the three companies shows some level of HCD practice, especially the use of evaluation techniques such as focus group meetings and user research methods such as ethnography (Hughes *et al.*, 1995; Viller and Sommerville, 1999), as well as stakeholders' meeting. There is also some level of iterative development, especially trying to gain users' feedbacks in order to improve the product. The affinity diagram technique was used to analyse the data from the interviews in order to conceptualize the development process in each company.

When it comes to development, each of the three companies has its own approach to the life cycle. However, there seems to be some commonalities among the three companies. Market survey is the initial effort in which companies come up with ideation of the product in order to enhance its acceptance.

> 'Market viability is very key (important) to us before we even start the environment (development).' (P6)

> 'The current situation with doing off the shelf application is that it gives you opportunity to understand the market, understand what the people require, and then you able to innovate accordingly and respond properly to market demands.' (P1)

However, the approach is slightly different at Omega where the team brainstorms on the project at hand.

> 'We first try to understand the project together. We both need to understand our coding approach together. We slice the works into bits and then merge at some point.' (P10)

TABLE 4. Companies' perceptions of humans in sociotechnical systems.

Human in sociotechnical systems	Gamma	Delta	Omega
Perception	Human is at the centre	The user is a complete novice	User is at the centre and should be kept in mind
Design rationale to support perception	Software solutions should be very intuitive to use	Systems should not be scary and should be very simple to use. Users should not be scared with too many menus and icons.	The designer should empathize with the user and software solutions should be simple to use.

Companies elicit product requirements from customers and do not involve the actual users. However, product requirements are usually not easy to gather for both Delta and Omega in custom development projects. The reason is that customers in many cases do not know they want.

> 'Our approach is apart from normal standards; clients don't understand what they want so we advise them.' (P8)

Some customers would simply use a known website as a frame of reference for providing their product requirements without considering associated costs.

> 'Customers want something quality like eBay and Ali Baba sites, but are not prepared for the costs associated with delivering replica of these websites.' (P8)

> 'We have more of those who say 'this is my problem and I want you to help me solve it'.' (P6)

Usability requirements are in many cases excluded from requirement and companies tend to be quiet on this in order not to put them into trouble (additional cost).

> 'Nobody write all those down. There is no point setting up yourself by putting those in a contract. However, some clients give you those measurable goals and you have to look into those.' (P6)

> 'Here, there is usually documentation for projects and even at that there are some cases where clients come to ask for additional requirement and in many cases have to back out as a result of lack of agreement to take responsibility for cost of additional requirements.' (P9)

Requirement gathering is, however, different for off the shelf products because the software is already written.

> 'We have business analysis where we review your business processes because that is where we now go into our solution design document, which is a solution of analysis of the requirements, because in many cases unlike bespoke software, we are selling off-the-shelf packages.' (P2)

The three companies also have unique approaches to product design. The process begins from product conceptualization where techniques such as brainstorming, market survey and ethnography are implicitly used to identify unmet and unidentified needs. However, this is just for conceiving a new product. The process continues iteratively where designs are crafted, evaluated, and sometimes there may be a need for redesigns. Focus group meeting is the popular evaluation technique in use at Gamma where members of staff of the company with varying IT skills and background are engaged in product evaluation. Not all the feedbacks are taken hook-line-and-sinker. Only important feedbacks are implemented. However, it is not so clear the basis for filtering feedbacks and modalities that are in place to ensure only useful feedbacks are implemented. There is a release of the beta version of the final version of a product is deployment. Figure 2 illustrates the process at Gamma.

The approach in Delta is such that after the initial market survey, company produces a prototype of the product using the rapid prototyping technique. After this, the product is re-introduced into the market (potential buyers or clients) to get quick feedbacks. The prototype is then updated until it is safe to go ahead with the product.

> 'The challenge most of the time is that the user doesn't know what he wants. It all depends on the user. You have to do more iteration. Our goal is to make the need of going back as minimal as possible.' (P7)

> 'We come up with an minimum viable product (MVP), and like even though this app has ten thousand features, if we can only commit ten features, ten very core features and finish the feature, then we can start selling.' (P6)

This process is usually for projects the company described as 'Company Project'. It is on the basis of coming with the MVP that the company writes the requirements and the project documentation. After the MVP, the company produces

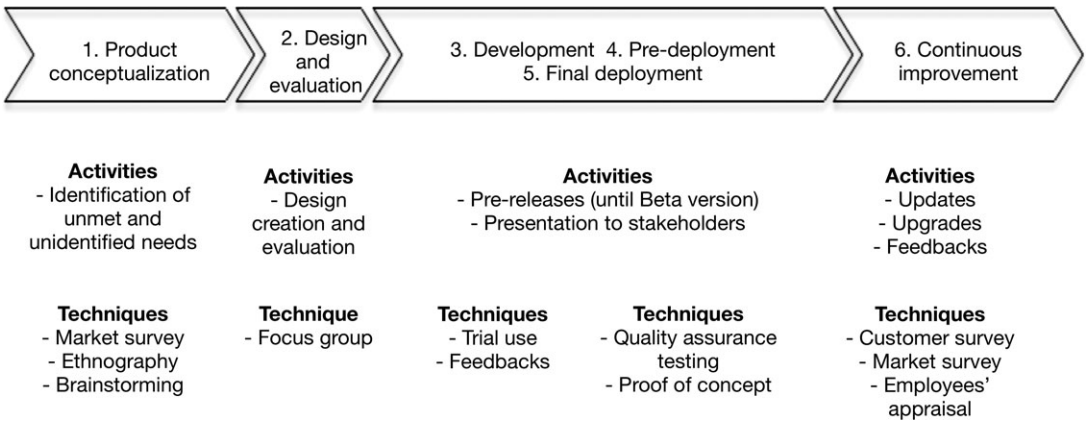

FIGURE 2. Product development process at Gamma.

wireframes and then coding would start thereafter. There is an indication that Nigerians prefer what is already built in many cases. Delta motivation for rapid prototyping is to reduce the costs associated with making later changes. The process at Delta is illustrated in Fig. 3.

> 'We used to do still prototyping, but now our prototypes are more interactive that you will think we have done the coding. The costs associated with making later changes when the solution has been fully developed are quite enormous. We want to minimise this as much as much as possible.' (P6)

Omega believes in the concept of showing the customer the first design. However, the company is being overwhelmed with having a lot of demos. Instead, the company now reviews what has been done and rework existing matching prototypes.

> 'What we do now is that we review the project and then do a prototype of it. Before we turn prototypes to HTML codes, we have to first agree on what has been done. It is after the agreement that we now move on.' (P8)

The process at Omega as can be seen in Fig. 4 appears to be the traditional waterfall, except that the process from the coding stage to testing and deployment is iterative. However, the cost of fixing bugs could be enormous for this company, considering that this is done after the coding stage.

In summary, the company produces the database, flow charts of how the application moves and sketches out the structure of the database. After these efforts, the company goes into coding of the application, then do testing, fix bugs and deploy.

The approach to testing the software for usability differs for each of the three companies. Omega indicates that testers are product owners and sometimes testers are internal staff at

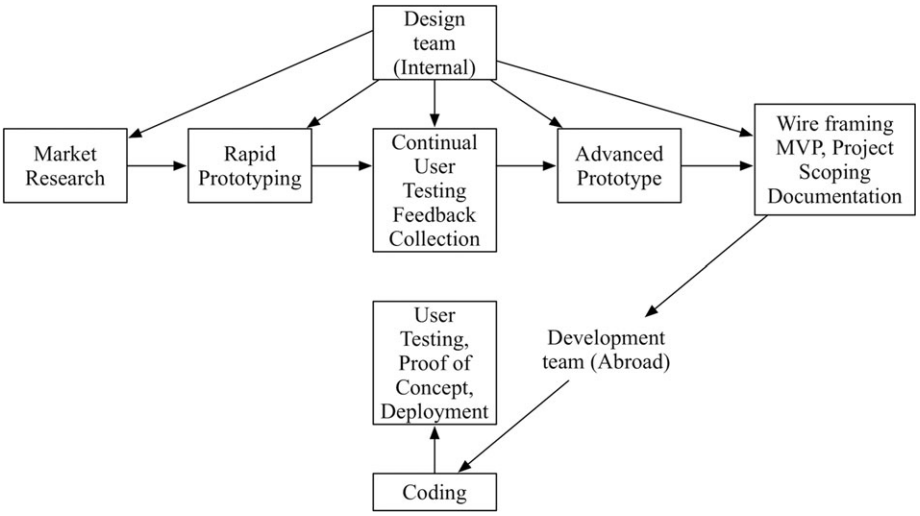

FIGURE 3. Product development process at Delta.

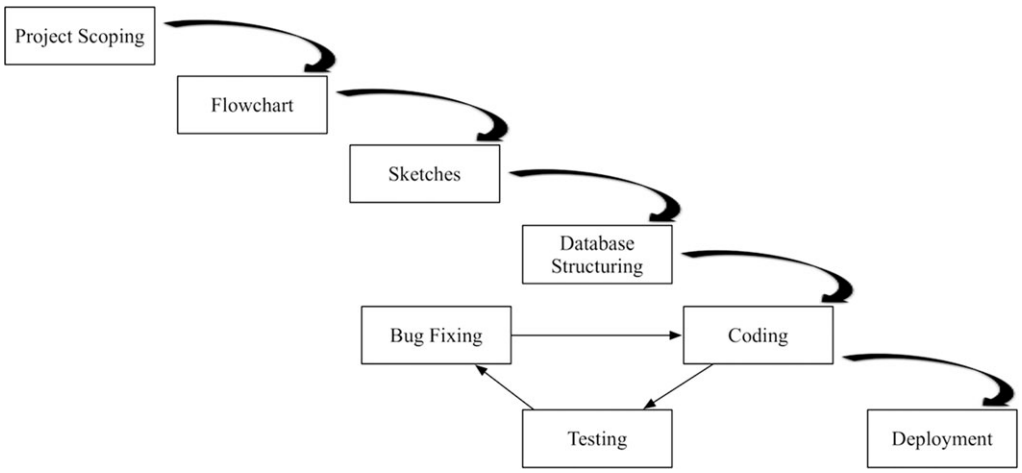

FIGURE 4. Product development process at Omega.

the customer's organization. This is however, done if the customer provides access to their staff. Some employees are recruited into a focus group at Gamma and provide feedback.

> 'As of now we don't have a program where we bring in external users to come and test our applications, So what we rely on are non-technical users in-house to say give me your perspectives, use this application and then from that (we collect) feedback.' (P4)

The rationale is that these employees are also users of the software. Similarly, Delta begins testing of the system being built by using in-house testers.

> 'We do it (testing) in-house; we are creating systems that normally involve the teachers, or students, the principal. Somebody takes the role of teachers, somebody takes the role of students, (and) somebody takes the role of principal.' (P6)

However, unlike Gamma, the rationale is to prevent unnecessary embarrassment when actual testers (clients) are recruited.

> 'This is the first level, the second level is for the actual users to test the system, then get feedback. The first level users (testers) give us feedback; we work on it before inviting the actual users to give us feedbacks. The idea is for us not to be disgraced before the actual users.' (P6)

The companies perceive software maintenance differently. For Gamma, the challenge of maintaining software appears to be a major reason for not going the direction of custom development.

> 'One of the problems with that model is that if as a company you acquire custom application, you may not have guaranteed support from your provider because they would have to maintain different code bases.' (P1)

However, both Delta and Omega have a different opinion regarding software maintenance. The major concern to these two companies is customer's unwillingness to pay for the maintenance.

> 'I think over here there is no respect given to software companies. For the projects, there is a consulting (maintenance) arm of the project. To the client, they believe they are one and the same, so, even when you are consulting for them and they ought to pay, they don't value it.' (P6)

> 'No! Nigerians don't even want support. They are not prepared for the cost associated with maintenance. It is only a few of the clients (companies) that want support.' (P8).

Additionally, Omega argues that other than cost, lack of project documentation is a reason for product maintenance challenges.

> 'Every project supposed to have project map (documentation) so that whosoever is coming later to support can understand how things have been done. Things like flow charts in such document would help.' (P8)

Overall, Omega argues that the lack of standardizing the Nigerian software industry is the major reason for companies' indifferences to product development.

> 'If you have standard practice in place, the issue of supporting clients or maintaining systems would not arise.' (P8)

Apart from Gamma and Omega that handle coding work in-house, Delta has outsourced its coding activities to a team based abroad. The major reason provided is a lack of requisite skills and expertise at home.

> 'We have graduates coming out of the universities and… the skills are not so good. They are not in touch with modern way of developing.' (P6)

4.3. Human-centredness assessments

We provide the assessment of HCD practice in the three companies, using the usability maturity model of Earthy (1998). The final ratings were based on the ratings for management practices and process attributes. We followed the rating procedure provided in Appendix 1, available in the supplementary material. Table 3 is the profile of all the interviewees. They are senior members of the project team in their companies as recommended by Earthy (1998). The interviewer, who is also the leading researcher assumed the role of a human factors consultant.

Step 1: As prescribed by the UMM-HCS, the first approach was to establish to what extent organizations are aware and mature with regard to HCD practice. This was achieved by basing the interview questions on the HCD principles defined by ISO 9241-210.

Step 2: In each company, at least one recent project was examined. In Gamma, however, based on their size, a project based on development of an e-payment software service and another on human resource management software were examined. A project based on e-learning software was examined in Delta. A project based on e-commerce website was examined in Omega.

Step 3: The interview with each interviewee lasted 45–60 min. The interviews went in such a way that interviewees had to explain their processes in line with the projects being examined.

Step 4: The interviewer listened for the ways users and customers were referred to and used the information to elicit further clarifications. For example, users are distinguished into super users (for example, IT managers) and day-to-day users (end users) at Gamma. In both Delta and Omega, users and clients (customers) were used interchangeably.

Step 5: The interview questions were carefully asked in such a way consistent with the maturity levels described in the UMM-HCS beginning with questions tailored to recognition for human-centredness. No further questions were asked when it became obvious the practices described in a certain higher level were not being achieved. There were few general questions though.

Step 6: Each practice was rated for each company's interviews based on the recommended scale of N to F.

Step 7: The form in Appendix 1, available in the supplementary material was used to calculate the overall rating of each company with regard to performance of human-centred activities.

The results in Table 5 show that the companies covered in this study are in the *Recognized* level. The results, however, show that Gamma tends towards the next level of maturity, i.e. *Considered* compared to Omega and Delta. Of the three companies, Omega appears to be the least inclined towards the next level. Since none of the companies have yet to advance to a higher maturity level, we considered the presentation of the remaining two levels, i.e. *Integrated* and *Institutionalized* as very unnecessary and not relevant to the overall result obtained. The summary of the results is in Table 6.

The modalities for determining the assessments in Table 5 were based on the responses to the interview questions collected across the representatives from each company and based on what was observed. Each of the products stated in step 2 were inspected and questions were asked in line with ISO 9241-210 framework and cross-checked across key members of the teams selected for interview. Due to confidential issues and ethical agreements with the companies the products cannot be fully described.

4.3.1. *Problem recognition and performed process attributes*

Basically Earthy (1998) stipulates that management and staff have to be fully aware of the need to improve certain aspects of the system being developed from use perspective. The rationale for rating a company is based on establishing evidences of achievements rather than perceptions. For example, we are interested in how companies have learnt from past failures and how they have been able to mitigate the situation by doing something different.

The e-payment solution at Gamma had initially been perceived as not so user-friendly, especially the aesthetic aspect of the system. What was done was to redesign the interface and give it more visually appealing colour scheme. Furthermore,

TABLE 5. Assessment of the companies' human-centredness.

			Companies		
Level	Process	Management	Gamma	Omega	Delta
A Recognized	**A1** Problem recognition attribute	**A1.1** Problem recognition	F	L	F
	A2 Performed process attribute	**A2.1** Information collection	L	P	L
		A2.2 Performance of relevant practices	L	P	L
B Considered	**B1** Quality in use awareness attribute	**B1.1** Quality in use training	L	N	P
		B1.2 Human-centred methods training	P	N	P
		B1.3 Human–system interaction training	N	N	P
	B2 User focus attribute	**B2.1** User consideration training	P	N	P
		B2.2 Context of use training	N	N	N
C Implemented	**C1** User involvement attribute	**C1.1** Active involvement of users	N	N	N
		C1.2 Elicitation of user experience	P	N	P
		C1.3 End user defines quality in use	N	N	N
		C1.4 Continuous evaluation	P	N	P
	C2 Human factor technology attribute	**C2.1** Provide appropriate human-centred methods	P	P	P
		C2.2 Provide suitable facilities and tools	P	N	P
		C2.3 Maintain quality in use techniques	N	N	N
	C3 Human factor skills attribute	**C3.1** Decide on required skills	P	N	N
		C3.2 Develop appropriate skills	P	N	N
		C3.3 Deploy appropriate staff	P	N	N

TABLE 6. Overall assessment result of HCD practice.

	Gamma	Delta	Omega
Maturity-level assessment	A (F + L)	A (F + L)	A (L + P)

there was a known problem with some functionalities of the system and what was done was to adopt responsive design.

> 'When I came in to work, that is 4 years ago now, our user interface is barely functional, there was not much aesthetic about it, we have a dull yellow colour then and controls were mainly fixed, so if you are using xyz (not the real name) on a (desktop) computer, it would be different to how it will appear if you are using it on an iPad. Some fields would be lost because of the smaller screen, it would be different to how it will appear on a mobile, more controlled systems because you are not yet on a smaller screen.' (P4)

> Our business model, our development approach or our idea that we should put everything on the hands of the end user, as many that everything we do, the colour, the shape, the spacing, everything, people have to make sure, does it even look well, read well, because that is the first thing they will see when they login, so we have to put more effort into how do people interact with this thing, what is the flow? Is it logical? (P2)

An e-learning application was inspected at Delta. The company indicated how they have learnt from the past and try to improve their attitude towards usability of the system. The product inspected appeared to be quite simple to use.

> 'We used to do still prototyping, but now our prototypes are more interactive that you will think we have done the coding. The costs associated with making later changes when the solution has been fully developed are quite enormous. We want to minimise this as much as much as possible.' (P6)

The major advantage Delta has is the fact the team in Nigeria only focus on design. The company's problem recognition attitude appears to be consistent across projects and among team members. For example, the company admits that they have embraced HCI implicitly because of market pressure.

> 'Maybe not structured, maybe it is the market that has taught the lesson. In trying to protect ourselves, we find ourselves implementing HCI.' (P6)

> 'Typically, the way it works here, on this side of the divide, it comes with three or four designs. We have found that it's not too effective. It is not cost effective on our own part. Typically, we insist that we need to have a one-on-one with you so we can able to capture your own idea.' (P7)

An e-commerce website project was inspected at Omega.

> 'Initially we do demos, however, in the end we realise we have a lot of demos. What we do now is that we review what we have done before. There is no kind of design needed now that can't be found in what we have done before. What we do now is that we review the project and then do a prototype of it. Before we turn prototypes to HTML codes, we have to first agree on what has been done. It is after the agreement that we now move on.' (P8)

Despite that there is recognition of problem with quality in use of products, there is a lack of consistency across projects and opinions differ among team members sometimes. For example, regarding the e-commerce website project, both the programmer and project manager have different opinions. When asked about how the project was initiated, and whether the user tasks and environment were clearly understood, the excuse given was time constraint.

> 'The challenge is that it is time consuming to do this. Normally, something that should have taken you an hour to do and because you have to pay attention to every petty detail involved, it goes a long way consuming much of your time. Getting to understand the users, with differing backgrounds, and the tasks and the environment being created is a lot challenging.' (P10)

Although the interviewer felt it could be because of lack of expertise, the response was that it is because of inadequate number of professionals in the team.

> 'No, It is not about expertise, it is more about the human resource available.' (P10)

When this issue was cross-checked with the project manager, the argument was different.

> 'The issue is, wanting the best but not (being) prepared for the cost trade-off. Still, many despite not knowing what they want would not accept anything short of the best. This is a challenge for us.' (P8)

4.3.2. Quality in use awareness and user involvement

As can be seen in Fig. 2, Gamma strives to build human-centred solutions, albeit the involvement of the actual users is not prioritized. For example, evaluation feedbacks are collected from client organizations at the management level and the actual users are not involved.

> 'End-users are coming later into things that have been developed in many cases. End-users will always make up their minds if this project or software is useful or not.' (P2)

The aspect of usability testing is lacking in most cases. There is some level of usability awareness in Gamma. However, there is a misconception regarding end users as customers are perceived more as users. Due to this reason, there is no involvement of actual users in projects.

> 'On projects, you are trying to deal with the key users, not the day-to-day users per-se.' (P2)

There is no laboratory to conduct user experience test, and although the company conducts a focus group to evaluate their products, the limitation is that company employees are used as users for such focus group activities. Thus, the company could not receive more than 'partial' rate for the attribute on user involvement.

> 'It is not that we have a big focus group we don't do this kind of thing, or we don't have a lab to say 'change the colour and see what people react to?' we don't do scientific experiment to decide what is the best colour scheme for this and that.' (P2)

> 'As of now we don't have a program where we bring in external users to come and test our applications, So what we rely on are non-technical users in-house to say give me your perspectives, use this application and then from that (we collect) feedback.' (P4)

Although usability is a part of quality criteria in software process improvement, there is no usability testing in quality assurance process in Gamma and just unit test, regression and integration. When asked specifically if the company prioritizes usability testing, the response shows that when talking about non-functional requirements, performance of the product is prioritized ahead of usability.

> 'No, I am talking about performance. How much of a load can our application accommodate? How many transactions can it turn at the same time? Those are the non-functional requirements I am talking about. Our priority is (to) let it work, (to) let it work fast.' (P4)

Nevertheless, error prevention is implemented by enforcing users to include the '@ sign' in an email field for example. Similarly, company guides the users by ensuring the system displays error messages, when a user does something wrong.

Similarly, Delta recognizes the need for human-centredness. The company tends to do design work in agile manner. This is evident in the way they have employed the use of rapid prototyping technique to gain quick feedback and redesign. The company uses human-centred evaluation methods such as rapid prototyping and wire framing. However, the company received a 'partial' rate for user focus and human factor technology attributes. Delta has a strong focus on design because only design activities are carried out in Nigeria; a team based in Europe carries out the aspect of development. There is a professional who is responsible for user interface design. There is no indication of interaction design and as a result, user experience is not being addressed. The only aspects of user experience values evidenced in product designs are intuitiveness and aesthetics.

The fundamental issue just as was seen in Gamma is still a lack of actual user involvement in projects, insufficient use of human-centred evaluation techniques at appropriate stages of the life cycle, training of team members to conduct HCD among others. Actual users are not involved in projects; only clients play proxy for end users. User requirements are elicited from project clients.

Omega has negative rates for most of the attributes, except the company at least recognized the need for human-centredness. The project manager in Omega doubles as the user interface designer. There is no indication of user involvement in projects and user feedbacks are received via user interaction with a test server. There is no face-to-face interaction with users. User requirements are elicited from clients. Usability awareness is very low and the only user experience value being prioritized is ease of use. The Company's major challenge lies with not having adequate number of professionals in the team. Another challenge, which Omega faces is the fact that although customers are interested in the functionality of the system, the user interface interaction raises lot of expectations and this places additional responsibility and still customers do not want to pay.

> 'They are interested in the functionality of the systems just that the interface usually raise a lot of expectation for the client.' (P8)

5. DISCUSSIONS

The results obtained from this study revealed there is no standard practice yet in place in the companies covered. The companies perceived human to be a critical component of sociotechnical systems, therefore they want their development approach to be user-centred. They focus on ease of use, aesthetics and intuitiveness of their products in order to bring their perceptions to reality.

Software development process for each of the three companies varies as can be seen from the analysis. Furthermore, each company has varying degrees of focus on software quality. Usually, software development project outcomes are in terms of the product quality, product size, development effort and cycle time (Puus and Mets, 2010). It is a known fact that software usability is influenced by software quality (Lacerda and von Wangenheim, 2018). The overarching concern, however, is that in many cases, software usability is not prioritized in software quality process (García-Mireles *et al.*, 2015). From the analysis of the interviews, it appears the companies do a bit of usability practice and a bit of sociotechnical systems development. For example, in both Gamma and Delta, evaluation of products are first done in-house using company staff and later with the clients. The rationale for product evaluation, especially from the insights gained at Delta seems to be for finding a fit for a product, that, is, to determine if the product will gain an acceptance rather than if it can be used by the user. However, usability engineering and sociotechnical systems development have not advanced in any of the three companies. For example, although Gamma has a quality assurance professional yet they are not doing anything scientific regarding usability of their products. They do not have UX or usability testing labs.

> 'Yes! I think we can get better too, I won't say it is totally scientific, It is not that we have a big focus group we don't do this kind of thing, or we don't have a lab to say 'change the colour and see what people react to?' we don't do scientific experiment to decide what is the best colour scheme for this and that.' (P2)

Similarly, Delta admits they still lack requisite skills to do HCI practice and Omega corroborates the fact that standards are lacking in the industry.

> 'I assume I have the expertise but not much challenge from the clients here in that regard, only few clients make demands on expertise. Lack of standard practice here is also a cover for many companies, but as the industry mature and become standardised,

expertise would become a major requirement for development companies.' (P6)

'There is no regulation. There are no laws being enacted to guide software development. Standards are lacking' (P9)

Product size and development effort refer to the lines of code required for a product and the associated number of persons required per time duration (Puus and Mets, 2010). The analysis of this paper shows that inadequate number of professionals involved in software development projects could be one of the challenges facing small development companies and this was indicated by Omega. Omega seems to have an approach similar to the traditional waterfall compared to the agile methodology at Gamma and Delta. This observation aligns with the outcome of a study by Vijayasarathy and Butler (2016), which indicates that there is a significant relationship between team size and adopted development approach.

Regarding awareness of HCI/HCD, the analysis shows the vast majority of the professionals interviewed are not familiar with terminologies such as HCI, ISO standards and sociotechnical systems. The professionals were only able to respond to the questions relating to these terminologies after the interviewer had offered some explanations what the terms meant. Lack of awareness is perhaps one of the major issues regarding HCI/HCD/usability practice. One major problem in many development companies to date is lack of following standard practice. A study by Hussein *et al.* (2011) revealed there is no significant different in the level of usability awareness among IT and non-IT professionals in the Malaysian IT industry. Further, the study revealed usability is perceived as 'common sense' knowledge among company practitioners. Therefore, although there is a higher degree of recognition of HCI/usability in practice, there is a lack of realization in practice. Similarly, a study conducted by O'Connor (2009) found that usability standards awareness in five Irish small and medium enterprises (SMEs) is low and these standards are perceived as too vague in real projects implementations. Moreover, companies are not using much of UCD techniques (Goncalves *et al.*, 2017; Venturi and Troost, 2004). Out of the three companies covered in Nigeria, none was aware of an ISO standard and framework for HCD practice. However, Gamma was aware of an ISO standard, and this is just on quality assurance (ISO 9001). This could be because of the inclusion of a quality assurance specialist in their team and accounts for the reason why Gamma has some edge over the two other companies regarding their human-centredness process. Development companies need to increase their awareness of usability standards and cost rationalization should not be a trade-off (Bevan, 2009). Furthermore, there is a need for development companies to make strategic investments into HCD practice.

One area the three companies still fall short of consideration of sociotechnical systems development is involvement of stakeholders. Although, the companies used own employees to gather feedbacks, the lack of actual users involvement limit their STS/HCI/HCD practice. There is a lack of government and customers' participation in projects too. End users' involvement can lead a company into focusing on concepts such as quality in use, and context of use as can be seen in the attributes for human-centred developments. Two of the companies, Delta and Omega, have difficulty in eliciting requirements from customers. These companies can benefit from accessing published results in the field of HCI and CSCW. For example, the structured digital storytelling technique can be used to elicit requirements in the context of ICT4D (Pitula and Radhakrishnan, 2011). Similarly, Molapo and Marsden (2013) proposed the Content Prototyping technique for addressing the problem of user involvement in participatory design as a result of users' lack of IT knowledge. Although these techniques are tailored to the developing context, lack of access to results by practitioners is another concern.

In contrast to the study by Wale-Kolade and Nielsen (2016), we do not see any indication of apathy regarding what the professionals perceived and what they do. In the case of three companies covered, we see instead, much limitation in that the companies have little knowledge of HCI and their rationale for adopting HCI approaches seems to be for survival in the market. HCI seems to be disruptive for one of the three companies covered. Perhaps, companies are forced into unconscious learning in this case. However, one of the companies seems to be sceptical and the reason for their scepticism is due to their limited budget.

One of the companies (Omega) claimed some Nigerian customers despite not knowing what they want, still demand for the best. Whilst this assertion requires further research to validate in the context of Nigerian software customers, existing knowledge reveals that customers despite not being able to express their needs (Rao *et al.*, 2011), want nice products delivered to them (Berntsson Svensson *et al.*, 2012). According to the company (Omega), one way some Nigerian customers demand for the best is by using existing websites such as Amazon and eBay, which have been built to international standards as a frame of reference. In this way, indigenous companies sometimes in a bid to deliver quality products implicitly use some HCI techniques as also revealed by another company (Delta) covered in this study. This finding is consistent with the study of Joshi and Gupta (2011), which indicated that use of the Internet and interactive products among Indians contributed to demand for HCI and usability design expertise in the local market.

With regard to HCDs practice, especially as prescribed by the ISO 9241-210 framework, software development organizations could be constrained by project timeline and delivery and this could be more challenging for development companies in Nigeria where companies tend to engage in community practice and use in-house methods (Aregbesola *et al.*, 2011; Egbokhare, 2014). Each of the three companies appears to

engage in some iterative design work. They used different approaches to gather quick feedbacks. Gamma does focus group, Delta does rapid prototyping, and Omega has a test server where the client can evaluate the system while it is being built. In some cases, these companies have to go the extra mile to understand what the client wants. Therefore, they cannot be said to be following any rigid process. Rather, they tend to follow what works for them. In the end, the customer accepts the product.

The overarching insight is that HCI practice has to be localized. HCI as a field has not gained traction in Nigeria. There are very few universities offering basic courses in HCI. The focus of these courses is on usability. Furthermore, there is a lack of HCI/HCD/usability awareness among end users or corporate customers. Towards resolving the awareness issue, one of the participating companies feel that a possible approach could be to localize HCI. This is consistent with the research work carried out by Smith *et al.* (2010).

> 'Yes, I also feel that localising HCI is (important). I think one good thing is being able to localise these paradigms (approaches). From my experience with other companies, everybody is doing their things without so much attention to standards and HCI stuff.' (P6)

This suggestion is also supported in the study by Winschiers-Theophilus and Bidwell (2013) where an Afro-centric HCI paradigm is proposed for HCD within the African context. The argument is 'current HCI paradigms are deeply rooted in a Western epistemology and intrinsically privilege certain assumptions, values, definitions, techniques, representations, and models' (Winschiers-Theophilus and Bidwell, 2013, p.253). The same assertion is observed by Chetty and Grinter (2007) when they argued that HCD techniques from the Global North have to be adapted to the context of the Global South. Similarly, Best and Smyth (2011) advocated to build efficient 'institutional support and organizational foundations for usability work in the Global South.'

Varying challenges regarding HCD implementation have been reported in some studies conducted in Africa and generally, the Global South. Some of the known challenges include accessibility issues and user involvement. In a study conducted in South Africa, a community-based co-design technique was used to overcome a challenge of designing a communication tool for deaf people who were said to be largely functionally illiterate (Blake *et al.*, 2014). The deaf persons require a solution to support them to understand their medications as prescribed by the doctors and correctly dispensed by the pharmacist. Deaf people in South Africa use South African sign language (SASL) and sign artifacts were redesigned to serve as an interpreter to SASL. Culture is a major challenge in Asian countries such as India and China (Liu, 2014). Literacy level, lack of expertise and the manner of HCI course curriculum in local universities are other challenges, which limit HCD in some countries in the Global South (Liu, 2014; Smith *et al.*, 2007).

The analysis of the three companies shows they are all at level 1 of usability maturity. Nevertheless, the analysis with the UMM-HCS suggests staged maturity models might not be suitable to assess small companies. Our analysis shows that the three companies tend to focus on the key phases of the development life cycle. The phases are requirement and analysis, design, coding, testing, deployment and maintenance. However, the assessment with the UMM-HCS limits the companies to level 1 because they are yet to fully fulfil the requirements at the initial level before moving to the next, even though it can be seen they are somewhat attending to some attributes found in higher levels. Perhaps, the practice in the three companies is ad hoc in nature. Another possibility could be the Western orientation of the instrument of measurement (UMM-HCS). Many of the existing studies conducted in Nigeria have used tools such as the CMM or CMMI to assess companies' maturity and usually companies are found at the initial level (see e.g. (Aregbesola *et al.*, 2011; Egbokhare, 2014; Eke and Okereke, 2010)). Perhaps, the discourse on localizing HCI should be extended to the design of maturity models. This could help to ascertain the true state of affairs within different contexts.

While it could be said that there is a low level of maturity in development companies in countries such as Nigeria (Egbokhare, 2014), other countries have different statuses. In India for example, the top 75% of the mainstream IT industry appears to be in maturity levels, which is above the unrecognized level and the top 25% are well above the implemented level but not up to the integrated level as described in the UMM-HCS model (Joshi and Gupta, 2011).

5.1. Reflections

Based on the outcomes of this study, there are few things to reflect on. First, it is possible that certain practices by software development companies connote some well-established practices in the HCI community and this is unknown to software development professionals. For example, in Gamma, conceptualization of software products emanates from a direct observation of people's practices in order to identify their unmet and unidentified needs and to develop solutions to meet such needs. This is ethnography and is used in software development process for eliciting requirements (Hughes *et al.*, 1995). Ethnography is also commonly used in the HCI discipline, and such approach was used at Xerox PARC (Grudin, 2012). However, throughout the interviews, although the process was described, the word 'ethnography', for instance, was never mentioned. This is described as tacit knowledge in the literature (Ardito *et al.*, 2014; Robinson *et al.*, 2007). Another example is the brainstorming technique used by the experts. Perhaps, practitioners might improve their attitudes if they are being supported to conduct reflective practices.

Second, whether the culture is off-the-shelf, bespoke or custom development, standards and values should not be comprised. Standards are there to shape practices. Although many SMEs from developing countries are not yet there, potentials exist for very few who have shown positive inclinations towards global competitiveness. The research community might be interested in taking a closer look at these organizations with a view to finding where commonalities already exist and where contextual implementations have brought certain challenges. In the case of two of the companies (Gamma and Delta) covered in this study, a push might be required for HCD dimensions to become standard practice and the CTOs in the two companies could be perceived as change agents considering their backgrounds, roles and interests. Companies at this stage can collaborate with the research community. Thus, if HCD is advanced in these companies, they could become a framework for existing and future indigenous software companies in Nigeria. To support our assertion, an example of such an effort in demonstrated through an action research where HCD was successfully integrated into a company's process (Viikki and Palviainen, 2011).

Third, from the case studies, we perceive that in an environment (national in this case) where the foundation for software development is still fuzzy and where development methods have yet to be standardized but conceived in-house by individual software organizations, the introduction of a structured practice such as HCD may not be automatic for uptakes. The international community should be aware of the contextual issues such as culture, and attitudes that differ from region to region. The companies investigated show a different attitude to HCD principles, which might be different to what companies in a developed country, would exhibit. These companies feel that some of the HCD principles, especially the principle for user experience are somewhat vague, fuzzy, and not realistic for them. According to the companies, end users do not seem to have much awareness of HCI approaches and perceived their involvement in projects as a share waste of their own time. Therefore, an alternative approach for those seeking to promote HCD and other HCI approaches in indigenous software companies would be to collaborate with these local companies and using local research institutions, as intermediaries would just be a good way to facilitate this kind of collaboration.

Fourth, not every small or medium companies, especially those found in the Global South are not innovative or strive to be innovative. From our study, we see that one of the companies (Delta) collaborates with a development team based abroad. Although the company is challenged by lack of expertise at home, we can see their effort to deliver successful products by collaborating with a team of developers based abroad. The insight that can be gained is that indigenous companies in the Global South can collaborate in order to deliver successful software products. One way collaboration is possible is in the fact that the Internet can be used to facilitate collaborative development environments. Although the cost of hiring HCI specialists might generally not be feasible for small companies, another approach could be to train some of the existing team members to conduct special HCI work tasks. This approach was used in the studies by Bruun and Stage (2015) and Øvad *et al.* (2015). In both studies, software developers from some Danish small companies were trained to conduct usability evaluation tasks. It might be interesting for future research, however, to find out what knowledge is being facilitated by this kind of collaboration. What kind of knowledge is shared across boundaries and what challenges might prevail? Outsourcing development is well known in India but the one we have seen in a company in Nigeria is such where the tasks of development is divided into requirement, analysis, design, deployment and maintenance, handled by the home team, and coding handled by the team abroad.

Finally, there is a question arising from this study, and it is to know which would be more realistic for small- and medium-sized companies, between improving their processes through a staged maturity representation assessment or a continuous maturity representation? Our concern is that many of the models available to companies are based on staged representations of maturity and it appears that small and medium companies would never be able to attain higher maturity levels. Do staged maturity models help companies to be acquainted with best approaches and tools they would need to develop or enhance their knowledge capacity? Although it is clear that staged representation helps companies to move from one level of maturity to another, continuous representation models could be used as complementary models to support staged maturity models as can be seen with the CMMI. The CMMI, for example, has been made flexible for companies to choose from a list of available models that suit their needs most (Carnegie Mellon University, 2002). Most of the models (examples include the UMM-HCS (Earthy, 1998), Corporate UX Model[7], KESSU Jokela (2004a, 2004b) and STRATUS (Kieffer and Vanderdonckt, 2016)) that have been developed in the field of HCI, are by staged representation models and we need to develop continuous maturity models to make process improvement assessments more holistic for development companies. From our own experience, small and medium companies feel more at home when they can continuously assess their processes and enhance their knowledge capacity building. Our argument is that as HCI practice is still at an infancy stage (due to low awareness and knowledge of HCI approaches, and other contextual issues) in many development companies found in developing countries (Ogunyemi *et al.*, 2015; Teka *et al.*, 2016), it could be worthwhile to support this set of companies with continuous representation models to assess and improve their HCI practices such as the HCD. Our assertion is consistent with a recent finding, which 'concluded

[7]Available at www.nngroup.com/articles/usability-maturity-stages-1-4 and www.nngroup.com/articles/usability-maturity-stages-5-8

that staged maturity models fail to enable organization-wide continuous process improvement. Organizations' (Uskarc and Demirörs, 2017, p.25). Another finding is that large companies and multinationals appear to have a different landscape for HCI practice. HCI practice appears to be more matured in large companies and multinationals because of their capability and for being majorly into consumer software. It is, therefore, not logical to assess small and medium companies with the instrument defined for large companies. For example, one of the major issues with the CMMI is that its goal is tied to the US Department of Defence' (DoD) need for military software. Thus, the CMMI was originally developed for assessing the capability of a vendor to produce military software that should be built within budget, to time and to specification (Carnegie Mellon University, 2002). Whether a balance between HCI process and HCI practice can, however, be achieved and successfully integrated into development processes could be something of interest to future research work.

6. CONCLUSION

The development of interactive systems for human use should be approached from the perspective of sociotechnical systems development and a good approach to achieving this is by following HCD practice. It is not so clear what perceptions companies regarding sociotechnical systems development and HCD are holding. Another issue is that still, not so much is known in companies located in developing countries.

This paper reports a study that explored the state of maturity of HCD practice in three indigenous software development companies in Nigeria. Three exploratory questions were raised in order to undertake this study. The interview technique was chosen and 10 interviews were conducted. Although humans are perceived as central to software systems, there are some known challenges that limit the realization of perceptions in the companies investigated. There is a limit regarding usability engineering and sociotechnical systems development in companies. The major concern is the fact that practitioners are not so familiar with these terminologies and appears to use HCI approaches implicitly. There is not so much familiarity with HCD techniques and few techniques are used implicitly. The three companies are currently in the least stage of maturity, that is, 'Recognized', using the UMM-HCS. However, there is evidence that the companies are already fulfilling some attributes found in higher levels of the UMM-HCS. Finally, assessments of indigenous small- and medium-sized companies based on stage maturity representation might not be sufficient and effective enough. The outcomes of this study revealed there is evidence of low awareness of HCD in the three companies, albeit the companies follow own methods to deliver successful products. The implication is therefore that HCI should be localized to contexts. Indigenous companies in the Nigeria might require more collaboration and researchers need to work from inside companies in order to help integrate HCD/HCI/STST into their companies' development processes.

7. LIMITATIONS AND FUTURE WORK

The results from this study are quite revealing and promising. However, there are some known limitations. First, Nigeria is a country with a population of over 180 million people and we have only covered three software development companies. Our sampling was snowball and the companies were found through some kind of networking, there is a possibility that some of the answers to the interview questions are based on a pre-knowledge of the interviewees. The results should, therefore, be interpreted with caution. However, we feel confident that the results are similar to studies conducted elsewhere. Moreover, none of the interviewees had any knowledge of the kind of questions they would be asked, except they knew the questions are central to HCI practice. The results also provide insights into how HCD may currently be practised in Nigerian small and medium software development companies. In our future works, we plan to explore how practitioners could be supported to conduct reflective practices towards HCD activities in projects. Precisely, we plan to investigate whether the use of self-assessment tool could trigger reflective practice and support maturation for human-centred development in software/IT development companies.

SUPPLEMENTARY MATERIAL

Supplementary data are available at *Interacting with Computers* online.

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REFERENCES

Akinola, O.S., Osofisan, A.O. and Akinkunmi, B.O. (2009) Industry perception of the software inspection process: Nigeria software industry as a case. Afr. J. Comput. ICT J. Comp. ICT, 2, 3–11.

Ardito, C., Buono, P., Caivano, D., Costabile, M.F. and Lanzilotti, R. (2014) Investigating and promoting UX practice in industry: an experimental study. Int. J. Hum. Comput. Stud., 72, 542–551. http://doi.org/10.1016/j.ijhcs.2013.10.004

Aregbesola, K., Akinkunmi, B.O. and Akinola, O.S. (2011) Process maturity assessment of the Nigerian software industry. Int. J. Adv. Eng. Technol., 1, 10–25.

Ashley, J. and Desmond, K. (2009). Usability Maturity: A Case Study in Planning and Designing an Enterprise Application Suite.

In Proceedings of the 1st International Conference on Human Centered Design: Held as Part of HCI International 2009', HCD 09 (pp. 579–584). Springer-Verlag, Berlin, Heidelberg.

Axelsson, K., Melin, U. and Lindgren, I. (2010) Exploring the importance of citizen participation and involvement in e-government projects: practice, incentives, and organization. Transforming Gov. People Process Policy, 4, 299–321. Retrieved from http://dx.doi.org/10.1108/17506161011081309.

Bannon, L.J. (2011) Reimagining HCI: toward a more human-centered perspective. Interactions, 18, 50–57. http://doi.org/http://doi.acm.org/10.1145/1978822.1978833

Baxter, G. and Sommerville, I. (2011) Socio-technical systems: from design methods to systems engineering. Interact. Comput., 23, 4–17. http://doi.org/10.1016/j.intcom.2010.07.003

Berntsson Svensson, R., Gorschek, T., Regnell, B., Torkar, R., Shahrokni, A. and Feldt, R. (2012) Quality requirements in industrial practice—an extended interview study at eleven companies. IEEE Trans. Softw. Eng., 38, 923–935. http://doi.org/10.1109/tse.2011.47

Best, M.L. and Smyth, T.N. (2011) Global/Local Usability: Locally Contextualized Usability in the Global South. In Douglas, I. and Liu, Z. (eds), Global Usability, Human-Computer Interaction Series. pp. 9–23. Springer-Verlag, London, Limited 2011. http://doi.org/10.1007/978-0-85729-304-6_2

Beyer, H. and Holtzblatt, K. (1998) Contextual Design: Defining Customer-Centered Systems. Morgan Kaufmann, San Francisco.

Blake, E., Tucker, W. and Glaser, M. (2014) Towards communication and information access for deaf people. S. Afr. Comput. J., 54, 10–19.

Bødker, S. (2006). When Second Wave HCI Meets Third Wave Challenges. In Proceedings of the 4th Nordic Conference on Human-Computer Interaction (pp. 14–18). http://doi.org/10.1145/1182475.1182476

Boivie, I., Åborg, C., Persson, J. and Löfberg, M. (2003) Why usability gets lost or usability in in-house software development. Interact. Comput., 15, 623–639. http://doi.org/10.1016/S0953-5438(03)00055-9

Bourimi, M., Barth, T., Haake, J.M., Ueberschär, B. and Kesdogan, D. (2010) AFFINE for Enforcing Earlier Consideration of NFRs and Human Factors When Building Socio-Technical Systems Following Agile Methodologies. In Bernhaupt, L.M., Forbrig, R. and Gulliksen, P.J. (eds), Human-Centred Software Engineering. HCSE 2010. pp. 182–189. Springer Berlin Heidelberg, Cham, http://doi.org/10.1007/978-3-642-16488-0_15

Bruun, A. and Stage, J. (2015) New approaches to usability evaluation in software development: barefoot and crowdsourcing. J. Syst. Softw., 105, 40–53. http://doi.org/10.1016/j.jss.2015.03.043

Bullinger, H.-J., Ziegler, J. and Bauer, W. (2002) Intuitive human-computer Interaction: toward a user-friendly information society. Int. J. Hum. Comput. Interact., 14, 1–23. http://doi.org/10.1207/S15327590IJHC1401

Carayon, P. (2006) Human factors of complex sociotechnical systems. Appl. Ergon., 37, 525–535. http://doi.org/10.1016/j.apergo.2006.04.011

Carnegie Mellon University. (2002). Capability Maturity Model integration: CMMI SM for Systems Engineering, Software Engineering, and Integrated Product and Process Development. Pittsburgh, Pennsylvania.

Chetty, M. and Grinter, R. (2007). HCI4D: How Do We Design for the Global South? In Proceedings of the User Centered Design and International Development Workshop at CHI 2007, 28 April-3 May, 2007 (pp. 1–2). San Jose, Ca: ACM.

Chilana, P.K., Ko, A.J. and Wobbrock, J.O. (2015). From User-Centered to Adoption-Centered Design: A Case Study of an HCI Research Innovation Becoming a Product. In Proceedings of CHI 2015 (pp. 1–10). Seoul: ACM.

Christensen, C.M. (2012) Disruptive Innovation. In Soegaard, M. and Dam, R.F. (eds), Encyclopedia of Human-Computer Interaction (Second. pp. 1029–1107. The Interaction Design Foundation, Aarhus N, Denmark. http://doi.org/10.5121/ijfcst.2014.4403.

de Bruin, T., Freeze, R., Kulkarni, U. and Rosemann, M. (2005). Understanding the Main Phases of Developing a Maturity Assessment Model. In Proceedings of the 16th Australasian Conference on Information Systems (pp. 1–10). Sydney: AIS.

Dillon, A. (2000) Group Dynamics Meet Cognition: Combining Socio-Technical Concepts and Usability Engineering in the Design of Information Systems. In E., Coakes, *et al* (eds), The New Socio Tech. pp. 119–125. Springer-Verlag, London.

Douglas, I. and Liu, Z. (2011) Global Usability. In Douglas, I. and Liu, Z. (eds), Limited. Springer-Verlag, London. Retrieved from http://dl.acm.org/citation.cfm?id=212925.212969.

Dubois, L.-E., Le Masson, P., Weil, B. and Cohendet, P. (2014). From organizing for innovation to innovating for organization: How co-design fosters change in organizations. In Proceedings of the AIMS Conference (pp. 1–23). Rennes.

Earthy, J. (1998). *Usability Maturity Model: Human Centredness Scale*. *INUSE Project Deliverable D5* (Vol. 5). Retrieved from http://www.idemployee.id.tue.nl/g.w.m.rauterberg/lecturenotes/usability-maturity-model[1].pdf

Earthy, J. (1999). *Usability Maturity Model: Processes* (Vol. Version 2.).

Earthy, J., Jones, B.S. and Bevan, N. (2001) The improvement of human-centred processes: facing the challenge and reaping the benefit of ISO 13407. Int. J. Hum. Comput. Stud., 55, 553–585. http://doi.org/10.1006/ijhc.2001.0493

Egbokhare, F.A. (2014) Causes of software/information technology project failures in Nigerian software development organizations. Afr. J. Comput. ICT, 7, 107–110.

Eke, B.O. and Okereke, N.C. (2010) Analysis of capability maturity model and software contract award in Nigeria. Int. J. Comput. Sci., 2, 1–7.

Fischer, G. and Herrmann, T. (2011) Socio-technical systems: A meta-design perspective. Int. J. Sociotechnol. Knowl. Dev., 3, 1–33. http://doi.org/10.4018/jskd.2011010101

Folmer, E. and Bosch, J. (2004) Cost effective development of usable systems: Gaps between HCI and SE. In Proceedings of the

ICSE 2004 Conference pp. 337–348. Springer, Boston, MA, http://doi.org/10.1007/978-0-387-36402-5_29

Fuchs, C. (2010) Theoretical foundations of defining the participatory, co-operative, sustainable information society. Inf. Commun. Soc., 13, 23–47. http://doi.org/10.1080/13691180902801585

García-Mireles, G.A., Moraga, M.Á., García, F. and Piattini, M. (2015) Approaches to promote product quality within software process improvement initiatives: a mapping study. J. Syst. Softw., 103, 150–166. http://doi.org/10.1016/j.jss.2015.01.057

Giacomin, J. (2012). What is Human Centred Design. In Proceedings of the 10 Congresso Brasileiro de Pesquisa e Desenvolvimento em Design (pp. 148–161). Sao Luis.

Giacomin, J. (2014) What is Human Centred Design? Des. J., 17, 606–623. http://doi.org/10.2752/175630614X14056185480186

Goncalves, T.G., de Oliveira, K.M. and Kolski, C. (2017) Identifying HCI approaches to support CMMI-DEV for interactive system development. Comput. Stand. Interfaces, 1–68. http://doi.org/10.1016/j.csi.2017.12.003

Grudin, J. (2012) A moving target—the evolution of human-computer interaction. In Jacko, J. (ed.), Human-Computer Interaction Handbook (3rd edn) pp. 1–40. CRC Press, Boca Raton, FL, USA.

Haesen, M., Coninx, K., Van Den Bergh, J. and Luyten, K. (2008). MuiCSer: A Process Framework for Engineering Processes. In Proceedings of HCSE/TAMODIA 2008 pp. 150–165. Pisa: Springer. http://doi.org/10.1007/978-3-540-85992-5_14

Harper, R., Rodden, T., Rogers, Y. and Sellen, A. (2008). *Being human: Human-computer interaction in the year 2020.*

Hughes, J., O'Brien, J., Rodden, T., Rouncefield, M. and Sommerville, I. (1995). Presenting ethnography in the requirements process. In Proceedings of the Second IEEE International Symposium on Requirements Engineering (pp. 27–34). IEEE. http://doi.org/10.1109/isre.1995.512543

Hussain, Z., Holzinger, A. and Slany, W. (2009). Current state of agile user-centered design: A survey. In Proceedings of the 5th Symposium of the Workgroup Human-Computer Interaction and Usability Engineering of the Austrian Computer Society on HCI and Usability for e-Inclusion (pp. 416–427). Linz: Springer. http://doi.org/10.1007/978-3-642-10308-7_30

Hussein, I., Mahmud, M. and Tap, A.O. (2011). A Survey of Usability Awareness in Malaysia IT Industry. In Proceedings of the 2011 International Conference on User Science and Engineering (i-USEr) pp. 146–151.

ISO. (1999). ISO 13407. Human-centred design processes for interactive systems. Geneve, Switzerland.

ISO. (2010a). Ergonomics of Human-System Interaction - Part 210: Human-Centred Design for Interactive Systems. In ISO 9241-210:2010 pp. 1–32. ISO. Retrieved from https://www.iso.org/obp/ui/#iso:std:iso:9241:-210:ed-1:v1:en

ISO. (2010b). Ergonomics of Human-System Interaction - Specification for the Process Assessment of Human-System Issues. Geneva.

Ji, J., Li, J., Conradi, R., Liu, C., Ma, J. and Chen, W. (2008) Some Lessons Learned in Conducting Software Engineering Surveys in China. In Proceedings of the ESEM'08, October 9–10, 2008 pp. 1–10. ACM, Kaiserslautern, http://doi.org/978-1-59593-971-5/08/10

Jokela, T. (2001). Assessment of user-centred design processes as a basis for improvement action: An experimental study in industrial settings. University of Oulu.

Jokela, T. (2004a). The KESSU usability design process model (No. 2.1). Oulu.

Jokela, T. (2004b) Evaluating the user-centredness of development organisations: Conclusions and implications from empirical usability capability maturity assessments. Interact. Comput., 16, 1095–1132. http://doi.org/10.1016/j.intcom.2004.07.006

Jokela, T., Siponen, M., Hirasawa, N. and Earthy, J. (2006) A survey of usability capability maturity models: implications for practice and research. Behav. Inf. Technol., 25, 263–282. http://doi.org/10.1080/01449290500168079

Joshi, A. and Gupta, S. (2011) Usability in India. In Douglas, I. and Liu, Z. (eds), Global Usability, Human–Computer Interaction Series pp. 153–168. Springer-Verlag, London, Limited. http://doi.org/10.1007/978-0-85729-304-6_9

Juristo, N., Moreno, A.M. and Sanchez-Segura, M.-I. (2007) Analysing the impact of usability on software design. J. Syst. Softw., 80, 1506–1516. http://doi.org/10.1016/j.jss.2007.01.006

Kesseler, E. and Knapen, E.G. (2006) Towards human-centred design: Two case studies. J. Syst. Softw., 79, 301–313. http://doi.org/10.1016/j.jss.2005.05.012

Kieffer, S. and Vanderdonckt, J. (2016). STRATUS: A questionnaire for strategic usability assessment. In Proceedings of the SAC 2016 Conference pp. 1–8. Pisa: ACM.

Kuusinen, K., Mikkonen, T. and Pakarinen, S. (2012). Agile user experience development in a large software organization: Good expertise but limited impact. In M. Winckler, P. Forbrig, & R. Bernhaupt (Eds.), Proceedings of the 4th International Conference, HCSE 2012 pp. 94–111. Toulouse: Springer. http://doi.org/10.1007/978-3-642-34347-6_6

Kuutti, K., Jokela, T., Nieminen, M. and Jokela, P. (1998). Assessing human-centred design processes in product development by using the INUSE maturity model. In K.S. NISHIDA & INOUE (Eds.), Proceedings of the Analysis, Design and Evaluation of Man-Machine Systems (7th IFAC/IFIP/IFORS/IEA Symposium, Kyoto, Japan, September). pp. 89–94.. Oxford: Pergamon Press.

Lacerda, T.C. and von Wangenheim, C.G. (2017) A Systematic literature review of usability capability/maturity models. Comput. Stand. Interfaces, 1–20. http://doi.org/10.1016/j.csi.2017.06.001

Lacerda, T.C. and von Wangenheim, C.G. (2018) Systematic literature review of usability capability / maturity models. Comput. Stand. Interfaces, 55, 95–105. http://doi.org/10.1016/j.csi.2017.06.001

Lamas, D., Zaphiris, P. and Christou, G. (2013). Promoting Human-Computer Interaction Values and Practices in Small and

Emerging Economies. In Special Interest Group at INTERACT 2013 p. 1.

Lanzilotti, R., Costabile, M.F., Ardito, C., Informatica, D. and Aldo, B. (2015). Addressing Usability and UX in Call for Tender for IT Products. In Proceedings of INTERACT 2015 conference pp. 1–8. Bamberg: Springer.

Law, E.L.-C. and Lárusdóttir, M.K. (2015) Whose experience do we care about? Analysis of the fitness of scrum and kanban to user experience. Int. J. Hum. Comput. Interact., 31, 584–602. http://doi.org/10.1080/10447318.2015.1065693

Liu, Z. (2002). An organisational human-centeredness assessment at Chinese software enterprises. In Proceedings of APCHI2002 pp. 251–259. London: Academic Press.

Liu, Z. (2014) User Experience in Asia. J. Usabil. Stud., 9, 42–50.

Maguire, M. (2001) Methods to support human-centred design. Int. J. Hum. Comput. Stud., 55, 587–634. http://doi.org/10.1006/ijhc.2001.0503

Marchiori, E., Pavese, G. and Cantoni, L. (2012). eTcoMM - eTourism communication maturity model. A framework to evaluate the maturity of a DMO when it comes to the online communication management: The case of Canton Ticino and Lombardy. In M. Fuchs (Ed.), Proceedings of Inormation and Communication Technologies in Tourism pp. 215–226. Springer-Verlag.

Melton, R.B., Zoltowski, C.B., Cardella, M.E. and Oakes, W.C. (2010). Work in progress: Development of a design task to assess students' understanding of human- centered design. In Proceedings of the ASEE/IEEE Conference pp. 26–27. Washington DC: IEEE.

Molapo, M. and Marsden, G. (2013). Content Prototyping – An Approach for Engaging Non-technical Users in Participatory Design. In P. Kotzé (Ed.), *Proceedings of INTERACT 2013 Conference* pp. 788–795. Springer-Verlag.

Momodu, I.B., Nnebe, S.E., Agbasi, K. and Idowu, S.F. (2007) Software development: An attainable goal for sustainable economic growth in developing nations: The Nigeria experience. Int. J. Phys. Sci., 2, 318–323.

Moreno, A.M., Seffah, A., Capilla, R. and Sánchez-Segura, M.I. (2013) HCI practices for building usable software. Computer, 46, 100–102. http://doi.org/10.1109/MC.2013.133

Norman, D.A. and Draper, S.W. (1986). *User Centered System Design: New Perspectives on Human-computer Interaction*. D.A. Norman & S.W. Draper, (Eds.). Taylor & Francis.

O'Connor, R.V. (2009). Exploring the role of usability in the software process: A study of Irish software SMEs. In M.R.R.V., Baddoo N., Cuadrago Gallego J., Rejas Muslera R., Smolander K. (Ed.), Proceedings of the European Conference on Software Process Improvement, EuroSPI 2009 (Vol. 42, pp. 161–172). Springer Berlin Heidelberg. http://doi.org/10.1007/978-3-642-04133-4_14

Ogunyemi, A., Lamas, D., Adagunodo, E.R. and Rosa, I. B. da. (2015). HCI Practices in the Nigerian software industry. In J. Abascal, S. Barbosa, M. Fetter, T. Gross, P. Palanque, & M. Winckler (Eds.), Proceedings of INTERACT 2015 conference (Vol. 9297, pp. 479–488). Cham: Springer International Publishing. http://doi.org/10.1007/978-3-319-22668-2

Øvad, T., Bornoe, N., Lars, B.L. and Stage, J. (2015). Teaching Software Developers to Perform UX Tasks. In Proceedings of OzCHI 2015 pp. 397–406. Melbourne: ACM. http://dx.doi.org/10.1145/2838739.2838764

Oviatt, S. (2006). Human-centered design meets cognitive load theory: Designing interfaces that help people think. In Proceedings of the MM 2006 pp. 1–10. Santa Barbara, California: ACM Press.

Pitula, K. and Radhakrishnan, T. (2011) On eliciting requirements from end-users in the ICT4D domain. Requirements Eng, 16, 323–351. http://doi.org/10.1007/s00766-011-0127-y

Puus, U. and Mets, T. (2010) Software Development Maturity Evaluation: Six Cases from Estonian SMEs. Balt. J. Manag., 5, 422–443. http://doi.org/10.1108/17465261011079785

Rao, K.N., Naidu, G.K. and Chakka, P. (2011) A study of the Agile software development methods, applicability and implications in industry. Int. J. Softw. Eng. Its Appl., 5, 35–46.

Rasmussen, L.B. (2007) From human-centred to human-context centred approach: Looking back over 'the hills', what has been gained and lost? AI Soc., 21, 471–495. http://doi.org/10.1007/s00146-007-0088-3

Robinson, H., Segal, J. and Sharp, H. (2007) Ethnographically-informed empirical studies of software practice. Inf. Softw. Technol., 49, 540–551. http://doi.org/10.1016/j.infsof.2007.02.007

Salah, D. (2013). Maturity Models in the Context of Integrating Agile Development Processes and User Centred Design. University of York.

Seaman, C.B. (1999) Qualitative methods in empirical studies of software engineering. IEEE Trans. Softw. Eng., 25, 557–572.

Shneiderman, B. and Plaisant, C. (2005) *Designing the user interface: Strategies for effective human-computer interaction* (Fourth). Pearson Education Inc, New York, USA. http://doi.org/10.1038/sj.bdj.2013.932

Smith, A., Bannon, L. and Gulliksen, J. (2010). Localising HCI practice for local needs pp. 114–123. Retrieved from http://dl.acm.org/citation.cfm?id=2227347.2227362

Smith, A., Joshi, A., Liu, Z., Bannon, L., Gulliksen, J. and Li, C. (2007). Institutionalizing HCI in Asia. In Proceedings of the 11th IFIP TC 13 international conference on Human-computer interaction (Vol. 2, pp. 85–99). Rio de Janeiro: Springer-Verlag. http://doi.org/10.1007/978-3-540-74800-7

Soriyan, H.A. and Heeks, R. (2004) *A Profile of Nigeria's software industry* (21). Precinct Centre, Manchester, UK.

Tanner, M. (2009) Communication and Culture in Global Software Development: The Case of Mauritius and South Africa. J. Inf. Inf. Technol. Organ., 4, 57–85. http://doi.org/10.28945/126

Teka, D., Dittrich, Y. and Kifle, M. (2016). Usability challenges in an Ethiopian software development organization. In Proceedings of the 9th International Workshop on Cooperative and Human Aspects of Software Engineering pp. 114–120. Austin, TX: ACM. http://dx.doi.org/10.1145/2897586.2897604

Tellis, W. (1997) Application of a case study methodology. Qual. Rep., 3, 1–18.

Thakker, D., Yang-Turner, F., Lau, L. and Dimitrova, V. (2011) Socio-technical ontology development for modelling sensemaking in heterogeneous domains. CEUR Workshop Proc., 809, 60–71. http://doi.org/10.1016/j.intcom.2010.07.003

Uskarc, A. and Demirörs, O. (2017) Do staged models enable organization-wide continuous process improvement? Insight from employees. Comput. Stand. Interfaces, 52, 25–40. http://doi.org/10.1016/j.csi.2017.01.008

Venturi, G. and Troost, J. (2004). Survey on the UCD Integration in the Industry. In Proceedings of the third NordiCHI Conference pp. 449–452. Tampere: ACM. http://doi.org/10.1145/1028014.1028092

Viikki, K. and Palviainen, J. (2011). Integrating human-centered design into software development: An action research study in the automation industry. In Proceedings - 37th EUROMICRO Conference on Software Engineering and Advanced Applications, SEAA 2011 pp. 313–320. http://doi.org/10.1109/SEAA.2011.54

Vijayasarathy, L.R. and Butler, C.W. (2016) Choice of Software Development Methodologies: Do Organizational, Project, and Team Characteristics Matter? IEEE Softw., 33, 86–94.

Viller, S. and Sommerville, I. (1999). Social analysis in the requirements engineering process: From ethnography to method. In E. Limerick (Ed.), Proceedings of the IEEE International Symposium on Requirements Engineering pp. 6–13. IEEE Computer Society Press.

Wale-Kolade, A. and Nielsen, P. A. (2016) Apathy Towards the Integration of Usability Work: A Case of System Justification. Interacting with Computers, 28(4), 437–450. http://doi.org/https://doi.org/10.1093/iwc/iwv016

Wendler, R. (2012) The maturity of maturity model research: A systematic mapping study. Inform. Softw. Technol., 54, 1317–1339.

Whitworth, B. and Ahmad, A. (2014) Socio-Technical System Design. In Soegaard, M. and Dam, R.F. (eds), The Encyclopedia of Human-Computer Interaction (2nd Ed., pp. 1–75). The Interaction Design Foundation, Aarhus, Denmark. Retrieved from https://www.interaction-design.org/encyclopedia/socio-technical_system_design.html

Winschiers-Theophilus, H. and Bidwell, N.J. (2013) Toward an Afro-Centric Indigenous HCI Paradigm Toward an Afro-Centric Indigenous HCI Paradigm. Int. J. Hum. Comput. Interact., 29, 243–255. http://doi.org/10.1080/10447318.2013.765763

Yin, R. (1994) Case Study Research: Design and Methods (2nd ed.). Sage Publishing, Thousand Oaks, CA.