Interdisciplinary Journal of E-Skills and Lifelong Learning

An Official Publication of the Informing Science Institute
InformingScience.org

IJELL.org

Volume 14, 2018

SOUTH AFRICA'S QUEST FOR SMART CITIES: PRIVACY CONCERNS OF DIGITAL NATIVES OF CAPE TOWN, SOUTH AFRICA

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ABSTRACT

Contribution	This study contributes to scientific literature by detailing the impact of specific factors on the privacy concerns of citizens living in an African city.
Findings	The findings reveal that the more that impersonal data is collected by the Smart City of Cape Town, the lower the privacy concerns of the digital natives. The findings also show that the digital natives have higher privacy concerns when they express a strong need to be aware of the security measure put in place by the city.
Recommendations for Practitioners	Practitioners (i.e., policy makers) should ensure that it is a legal requirement to have security measures in place to protect the privacy of the citizens while collecting data within the smart city of Cape Town. These regulations should be made public to appease any apprehensions from its citizens towards smart city implementations. Less personal data should also be collected on the citizens.
Recommendation for Researchers	Researchers should further investigate issues related to privacy concerns in the context of African developing countries. Such is the case since the population of these countries might have unique cultural and philosophical perspectives that might influence how they perceive privacy.
Impact on Society	Cities are becoming "smarter" and, in the context of developing countries, privacy issues might not be such a major concern as is the case in the developing world.
Future Research	Further qualitative studies should be conducted to better understand issues related to perceived benefits, perceived control, awareness of how data is collected, and level of privacy concerns of digital natives in developing countries.

Accepted by Editor Fay Sudweeks | Received: March 10, 2018 | Revised: March 11, March 21, 2018 | Accepted: March 23, 2018.

Cite as: Tshiani, V., & Tanner, M. (2018). South Africa's quest for smart cities: Privacy concerns of digital natives of Cape Town, South Africa. *Interdisciplinary Journal of e-Skills and Lifelong Learning, 14,* 55-76. https://doi.org/10.28945/3992

Keywords smart cities, privacy concerns, digital natives, developing countries, South Africa

INTRODUCTION

Several cities around the world are moving towards acquiring the "smart city" status and several African cities are joining this quest (Anthopoulos & Fitsilis, 2013; Watson, 2015). A smart city is a city that incorporates the use of Information and Communication Technologies (ICT) and the Internet of Things (IoT) in the management and monitoring of city resources (J. Lee, Hancock, & Hu, 2014). Cities such as Vienna and Barcelona are establishing themselves as world leaders in the smart city movement (March & Ribera-Fumaz, 2016; Schleicher, Vogler, Inzinger, & Dustdar, 2015).

The concept of smart cities in the African context is new and still needs more exploration (Chourabi et al., 2012; Nfuka & Rusu, 2010). Moreover, smart city implementations in African cities are still lagging behind those of European cities (Watson, 2015). Nonetheless, many African cities such as Cape Town in South Africa and Nairobi in Kenya have implemented smart city projects such as free Wi-Fi in public places and cashless payment systems for public transport (Albino, Berardi, & Dangelico, 2015; J. Lee et al., 2014). In addition, many of the smart city services that can be found in self-described European smart cities such as Barcelona can also be found in Cape Town (Volkwyn, 2017).

Data is constantly being produced and consumed in smart cities (Kitchin, 2015). Data from different sources are integrated together, with the aim of acquiring a full picture of the city's status in terms of safety and economic vitality and in terms of resources usage (March & Ribera-Fumaz., 2016). As a result, generating and using this data often raises issues around data security and data privacy (Li, 2012).

RESEARCH PROBLEM

With this current period being coined as 'the digital age', it is not surprising that one of the challenges of our time is privacy (Acquisti, Taylor, & Wagman, 2016). In today's society, the threat of personal data being abused for financial gain, social discrimination, or coercion is real (Edwards, Hofmeyr, & Forrest, 2016). In the past, there have been several instances where people's personal information was collected by government agencies without their awareness. An example of such an incident was when it was revealed by WikiLeaks that a United States government agency called the National Security Agency (NSA) collected personal information such as phone records, emails, bank transactions, travel records, and Internet searches of millions of people (N. Lee, 2015). It cannot be assumed that these highly publicised incidents of people's information being used without their awareness and consent went unnoticed by digital natives in Cape Town, South Africa.

Smart city projects have been known to bring benefits to cities such as sustainable economic development (Castro, Jara, & Skarmeta, 2013). However, one may wonder how certain factors influence the privacy concerns that come along with the implementation of smart cities, particularly in the African context. In a time when information can be easily transferred, accessed ,and even shared, it is no surprise that people may have inclinations to be very protective of their personal information (Elhai, Levine, & Hall, 2017).

RESEARCH PURPOSE

Many studies have been done on smart cities in Europe and in emerging economies like the Far East. However, Backhouse (2015) states that "little has been done to understand how this concept is playing out on the African continent, although many African cities are pursuing smart city agendas" (p. 1). The objective of this study is, therefore, to investigate the impact of awareness, perceived benefits, types of collected data, and perceived control on the privacy concerns of digital natives living in the smart city of Cape Town, South Africa.

In line with the objective of the study, the research question is:

What is the impact of need for awareness, awareness of data collection method, perceived benefits, types of data collected, and perceived control on the privacy concerns of digital natives living in the smart city of Cape Town, South Africa?

The study specifically investigated the privacy concerns of the citizens (foreign & local) of Cape Town born between the years of the late 1980s to mid-1990s. While the privacy concerns of non-citizens (i.e., visitors) are also relevant, the study specifically focuses on citizens as they are the ones who reside in the city on a long term basis. This was investigated using a quantitative approach.

Importance of the Study

It is important to study the implementation of smart cities in Africa as research shows that by 2050 almost 70% of the world's people will live in cities (Shanahan et al., 2017). Law makers of African cities need to find efficient ways to accommodate all these people and encourage them to use smart cities technologies. The purpose of this is to reduce the likelihood of African cities investing massive amounts of money into a smart city projects that may end up eventually failing (Backhouse, 2015).

Literature Review

This section examines the current literature relating to the characteristics and implementations of smart cities in Cape Town, South Africa and the privacy concerns associated with smart cities.

Characteristics of Smart Cities

Cities around the world are attempting to transform into smart cities, in order to be more economically competitive and promote sustainable growth (Roche, Nabian, Kloeckl, & Ratti, 2012). According to past studies, the most common characteristics of Smart Cities are "Smart" Governance, "Smart" Environment, "Smart" Living Environment, and a "Smart" Economy.

- "Smart" Governance relates to the use of digital technology in public and government organisations as well as in social services (Rosati & Conti, 2016). Having an efficient and intelligent transportation systems is what makes a city 'smart' in relation to governance (Kondepud et al., 2016). An example of a city's smart governance initiative is the usage of Information Technology (IT) (e.g., Smart LEDs) to monitor and lower the Energy consumption within the city (Chourabi et al., 2012).
- "Smart" Environment relates to sustainable resource management through the use of ICT (Caragliu, Nijkamp, & Del Bo, 2011). A city with a "smart" environment makes use of big data, IoT, and various other technologies in the running and planning of the city's infrastructure and during the provision of city services (Chourabi et al., 2012).
- A "Smart" Living Environment provides benefits for the people living in the city such as free public Wifi, access to e- health, access to smart building services and access to e-education solutions (Kondepud et al., 2016).
- A "Smart" Economy promotes the use of electronic business processes in the city such as e-banking, e-shopping, and e-auction (Kondepud et al., 2016).

Smart City Implementation in Cape Town

Cape Town has often declared that it aims to be a more competitive city with rapid economic growth and economic development (Anthopoulos Fitsilis, 2013; Maumbe, Owei, & Alexander, 2008). Urban development is a priority in Cape Town, as the city continuously receives flocks of South Africans from rural areas and non-south Africans looking for employment and accommodation (Odendaal,

2006). E-government is one the main focus points of Cape Town's smart city strategies (Lourie, 2017). Another focus area in Cape Town's smart city agenda is to provide social and economic development to its citizens by improving ICT skills (Lourie, 2017).

Cape Town has started to use more technology in its day-to-day management (Volkwyn, 2017). In particular, smart metering is being used for electricity and water in 65% of the city's large administrative buildings (Baud, Scott, Pfeffer, Sydenstricker-Neto, & Denis, 2015). In the past, Cape Town has also introduced smart city projects such as the SMART Cape Access (Khati, 2013). The aim of the SMART Cape Access Projects was to provide Cape Town citizens with free access to technology (Valentine, 2004). The project was started in July 2002 and resulted in the installation of 36 Internet enabled computers in six public libraries in poorer areas across the city (Valentine, 2004).

More recently, Cape Town city management has rolled out public Wi-Fi in many areas around the city and actively endeavoured to improve the city's broadband infrastructure in order to reduce the digital divide (Volkwyn, 2017). According to Volkwyn (2017), in order to make Cape Town "Smarter" there has also been an increase in the usage of Closed-Circuit Television (CCTV) cameras in the city. In particular, city management has installed 560 cameras in and around the city in order to make the city safer (Volkwyn, 2017).

Reports on smart city projects in Cape Town often omit information on privacy concerns of the citizens (Smit, Makanga, Lance, & de Vries, 2009). One possible reason for this omission is that smart city initiatives often overshadow the privacy concerns that these projects may bring about (van Zoonen, 2016).

Privacy Concerns in Smart Cities

In a city that relies on smart technologies, everyday activities performed by people leave trails of data on their interests, habits, and intentions (Acquisti et al., 2016). Research shows that people around the world are unknowingly constantly revealing information about themselves to commercial entities, governments, and sometimes to hackers (Acquisti et al., 2016). However, studies show that what data is deemed as private and sensitive varies from person to person, based on one's own cultural and societal definition of privacy (Alashoor, Aryal, & Kenny, 2016; Taddicken, 2014).

When individuals have higher privacy concerns, they will more likely want to protect their data and are less likely to disclose their information to entities that they do not trust (Beuker, 2016). Nonetheless, several research findings also show that, despite the possible privacy concerns in smart cities, these are often overshadowed by the possible benefits of the data collected (van Zoonen, 2016). These findings are in line with the "The Price of Convenience (PoC)" theory (Ng-Kruelle, Swatman, Rebne, & Hampe, 2002) which states that most people are willing to forgo their privacy concerns and privacy rights for the conveniences received in return (Hann, Hui, Lee, & Png, 2007).

Privacy Concerns in South Africa

Threats related to the leakage of personal information of citizens in South Africa may not be common but still occur. Olinger, Britz, and Olivier (2007) write that, in June 2004, it was reported by several South African newspapers that "the South African Post office would sell the personal information of the registered citizens contained in its National Address Database (NAD)" (p. 32). The personal information compromised of data such as the individual's name, identity number, home address, and telephone numbers that were taken from the Ministry of Home affairs in South Africa (Olinger et al., 2007). Even though there are legal protections in South Africa against the misuse of personal information by someone else, illegal interceptions of electronic communication by various people and institutions in South Africa still occur (Harris, Goodman, & Traynor, 2013). In order to specifically look at the privacy concerns of citizens in an African city in relation to smart city implementation, Backhouse (2015) states that future empirical studies are needed to unpack the various nuances of smart city agendas in the African context.

Privacy Concerns in Africa

Research has shown that the widely acknowledged and practiced African philosophy of Ubuntu has greatly influenced the perceptions around privacy in Africa in terms of values and social thinking (Anteneh, Belanger, Borena, & Ejigu, 2015). The philosophy identifies "personhood", which is the rights afforded to a person, as being determined not only by the individual person but largely by the community he or she lives in (Muyia & Nafukho, 2017). Ubuntu values initiatives and actions that will collectively benefit the community even more than the rights of the individual (Makulilo, 2015). In Africa, it can thus be perceived that privacy is determined by the collective society as opposed to being determined by one's own personal beliefs (Borena, Belanger, & Egigu, 2015), which is in contradiction with current western values when it comes to the usage of technologies (Borena et al., 2015). It is said that the concept of privacy and the concept of an individual being self-autonomous is a western concept that has no roots in the African culture (Makulilo, 2015).

By virtue of the fact that it is a generally accepted theory that Africans live in and have a collectivist culture (Harris et al., 2013), it is also theorised that Africans put no value on digital privacy (Olinger et al., 2007). However, Makulilo (2015) notes that this assumption is not necessarily true, and it does not mean that because of the collectivist culture in Africa, there is a lack of understanding and value of privacy in African countries. Makulilo (2015) hypothesised that the desire for African countries to engage in the global e-Commerce market, will force many African governments and people to reconsider their ideas of privacy.

The Multidimensionality of Privacy Concerns in Smart Cities

Research shows that people's informational privacy concerns are affected by not only personal psychological factors, but also external influences (Hsu & Shih, 2009). Consensus in existing research indicates that there are four main factors that influence informational privacy concerns. These are Perceived Benefits, Type of Data Collected, Awareness, and Perceived Control.

- *Perceived Benefits:* Research shows that, for most individuals, if they perceive more benefits than risks, they are then willing to accept the risks and thereupon disclose information. Beuker (2016) and Barth and de Jong (2017) state that, even though people may claim to value their informational privacy, in truth, once they estimate the benefits from the information disclosure, personal information can then be traded. In line with the theory of "The Price of Convenience (PoC)", it is often found that the calculated value of the benefits often outweighs the estimated costs of information disclosure (Culnan & Bies, 2003; Olivero & Lunt, 2004).

- *Type of Data Collected:* According to research, privacy concerns are often determined by the type of information that is being disclosed. Van Zoonen (2016) states that most people consider certain data types as more personal than others, and what people deem as personal information is not always consistent and is dependent on individuals' own definition. Generally speaking, the types of information can be categorised in two groups: personal information and impersonal information (van Zoonen, 2016). Impersonal information includes data such as gender, languages spoken, and home town while personal information contains data such as profile pictures, emails, phone numbers, and personal views/preferences (Beuker, 2016). Research shows that many people believe and fear that snippets of personal information can easily be combined into highly personal consumer profiles (Harris et al., 2013; Tene & Jules, 2013). Impersonal data, on the other hand, is likely to illicit low levels of privacy concerns as this data tends to reveal nothing about individual people (van Zoonen, 2016).

- *Awareness:* Uncertainties on how personal information is collected, used, and shared result in high levels of privacy concerns (Beldad, 2011). An individual's decisions of whether or not to share personal data in a particular environment often depends on an awareness and evaluation of the information supplied about the privacy policies implemented in that particular

environment (Beldad, 2011). According to Dinev and Hart (2014), most people need to have an awareness of the risks involved before making a decision.

Uncertainties often stem from environments that are ambiguous and complex (Dinev & Hart, 2014). Research shows that peoples' uncertainties regarding the usage and the processing of their personal information often triggers feeling of information privacy violations, which could lead them to a disengage from the environment or cause disruptions in the environment (Weltevrede, 2011). Being aware of the methods and technologies used in the data collection of one's personal information is also another factor that influences privacy concerns (van Zoonen, 2016).

- *Perceived Control:* According to Beldad (2011), most people tend to favour the ability to filter the flow of their personal data regardless of the environment they are in. Beldad (2011) further theorises that when people have control of how their personal information is collected, used and shared, this lowers their privacy concerns. Several studies have identified that an individual having a perception of control over their personal data is an important factor in encouraging people to partake in smart city initiatives (Stewart & Segars, 2002). Control over one's personal information can be exercised in two ways: before and after the information is disclosed (Beldad, 2011). Moreover, control over one's personal information can be achieved through various means such as choice, consent, access to the data, and the ability to provide correction of the data (Beldad, 2011).

Digital Natives in Cape Town

Research shows that in the western world it is often perceived that because digital natives grew up with technology, the way they think, behave, and act is shaped by digital technologies (Gu, Zhu, & Zuo 2013; Hoffmann, Lutz, & Meckel, 2014). Identifying digital natives in South Africa and other developing countries is not as easy as it is in the western world due to vast wealth gaps in many developing countries (Thinyane, 2010). A digital native in South Africa was born in a time where there was an increase in the usage of technologies in the world, but because of their economic background and racial discrimination, they might not exhibit the same technological proficiencies and inclinations as those of digital natives in western world (Thinyane, 2010). The legacy of Apartheid in South Africa also had an impact on the uptake of technology by people who fit in the age group of the world's digital natives (Thinyane, 2010). Many of South Africa's digital natives still do not have access to the technologies that were made popular when they were born (Maumbe et al., 2008). Understanding the patterns of access and use of technology by South African digital natives is essential in to hypothesise and understand their privacy concerns (Thinyane, 2010).

Research shows that age influences the behaviour and perceptions of a user of technology. Brown and Czerniewicz (2010) argue that this view is not true in the South African context. Brown and Czerniewicz (2010, p.48) agree with Thinyane (2010) in arguing that in South Africa "age is not a determining factor in students' digital lives; rather, their familiarity (awareness) and experience (exposure) using ICTs is more relevant". In South Africa, those who demonstrate digital native attributes are an elite minority (Brown & Czerniewicz, 2010). The digital native population in South Africa consists of a varied group that has a wide variety of information technology competences (Thinyane, 2010). However, research shows that although in the African region only one in ten young people may be digital natives, it is these young people who are often their nation's drivers in terms of using the Internet and technologies (International Telecommunication Union, 2013).

Summary of the Literature

The literature review found that there is a growing trend of incorporating smart city initiatives in cities all around the world. Although smart city initiatives have the potential to bring various benefits, literature shows that these benefit can sometimes be overshadowed by security and privacy concerns.

In the African context, these privacy and security concerns differ from those of the western world due to differences in culture, economic capabilities, and access to technologies. Cape Town is currently involved in several smart city projects. Therefore, in order to encourage participation in these smart city initiatives, privacy concerns need to be investigated.

THEORETICAL FRAMEWORK & HYPOTHESES

THEORETICAL FRAMEWORK AND CONSTRUCTS

As discussed in the previous section, the main factors that might influence the privacy concerns of people living in smart cities are Perceived Control, Awareness, Perceived Benefits, and Type of Data Collected. The awareness construct was split in two so as to separately investigate the citizens' need for awareness of practices and policies and their actual awareness of methods and technologies used to collect data. A summary of these factors are provided in Table 1.

Table 1. Factors impacting privacy concerns in smart cities

Constructs	Description
Perceived Control	The extent to which citizens perceive that they have control over how their personal information is collected and if they have an option to opt-out of the data collection process (Stewart & Segars, 2002).
Awareness of data collection	This construct relates to an awareness of the methods and technologies that are used to gather/collect data in a smart city (Stewart & Segars, 2002).
Need for awareness	The extent to which citizens need to be aware of smart city's privacy practices and polices – in terms of rules determining access of the data (Beldad, 2011).
Perceived benefits	The perceived benefits and conveniences received in return for granting access to personal data (Ng-Kruelle et al., 2002).
Type of data collected	The perceived nature of the data that is collected (Ng-Kruelle et al., 2002).

The framework that was used in this study is shown in Figure 1. The dependent variable is the levels of privacy concerns of citizens living in the smart city of Cape Town. The independent variables were summarised in Table 1.

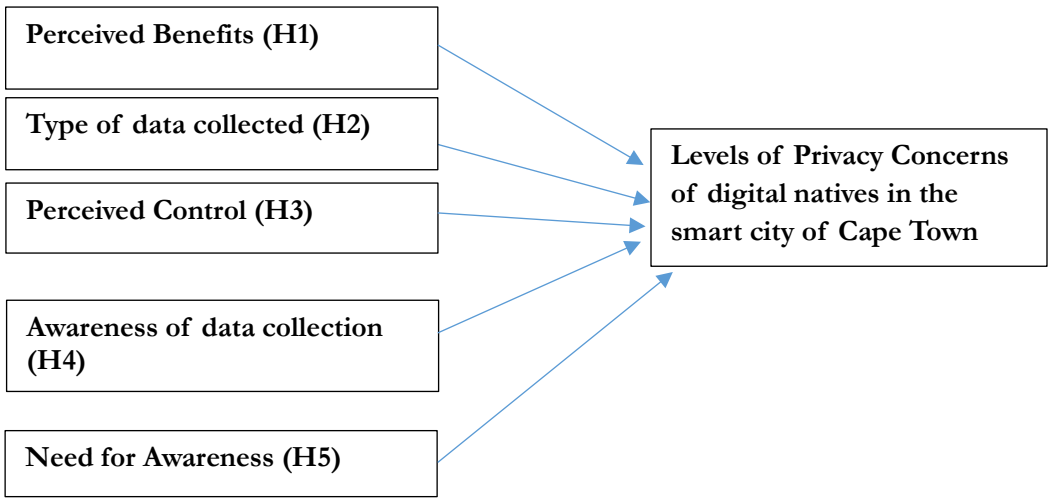

Figure 1: Theoretical Framework

HYPOTHESIS

The hypotheses derived for the study are:

H1: The more digital natives perceive to receive benefits from providing personal data to the smart city of Cape Town, the lower their privacy concerns.

H2: The more impersonal the data being collected by the smart city of Cape Town is, the lower the privacy concerns of the digital natives.

H3: The more digital natives perceive to have control on the data collected about them by the smart city of Cape Town, the lower their privacy concerns

H4: The more the digital natives are aware of how their personal data is collected by the smart city of Cape Town, the lower their privacy concerns

H5: The higher the need to be aware of the security measures put in place during the collection and storage of their personal information by the smart city of Cape Town, the higher the privacy concerns of the digital natives

RESEARCH METHODOLOGY

RESEARCH APPROACH AND PHILOSOPHY

The study adopted a positivist philosophy as the data to be collected is objectively observable and quantifiable. In particular, the study involves finding a cause and effect type of relation. A deductive approach to theory was also chosen as positivists and quantitative studies are usually deductive in nature (Greener & Martelli, 2014). The research strategy was quantitative and involved the collection of numerical data for the purpose of getting precise measurements which can then be converted into useable statistics (Bhattacherjee, 2012).

Since the aim of this study was to identify the current privacy concerns of a certain group of people in Cape Town, a cross- sectional approach was best suited as it provides a present-day "snapshot" of a point of view (Greener & Martelli, 2014).

RESEARCH METHODS

Instrument

An online survey questionnaire of closed questions was the chosen research instrument in this study. An online questionnaire was chosen as it provided anonymous access to groups and individuals who would otherwise be difficult to reach in a short amount of time and in large numbers through other channels. Online surveys also kept the costs for the study to a minimum (Wright, 2005).

In addition to demographics questions, the survey consisted of questions that correspond to each of the constructs in the research framework, namely, Perceived benefits, Type of data collected, Perceived Control, Awareness of Data Collection, Need for Awareness, and Levels of Privacy Concerns.

A Likert scale was used to allow the respondents to indicate their opinions, attitudes, or feelings about a particular issue. A Likert scale with an odd number of options was used. In particular, a 5 point Likert scale of 1 =Strongly disagree, 2 =Disagree, 3 = Both Agree and Disagree, 4 =Agree, 5 = Strongly agree was used.

In order to protect the identity and views of the research population used, all surveys responses were anonymous. Importance was put in maintaining the confidentiality of the data collected and produced in this research. The codes of ethics prescribed by the University of Cape Town were followed while researching was being done.

The online survey questionnaire was sent with a brief introduction note, stating the purpose of the study and a brief description of the study. The introductory note stated that participation in the research was voluntary and participants could opt out of the survey questionnaire at any time.

Participant recruitment

In developed countries, people born in the late 1980s and early 1990s are considered to be digital natives as they are presumed to have grown up in the age of technology (Boyd, 2013). However, due to large wealth inequalities within the South African population, there exist differences in exposure to technologies within this age group (Triegaardt, 2009). Hence, the research population of this study has been limited to Cape Town citizens born in the late 1980s and early 1990s but who also grew up with an exposure and awareness of the popular technologies. Participants were allowed to partake in the survey if their response to the following question was "yes": "Did you have access to a computer and/or Internet during your primary school years (access of this can come from anywhere and is not limited to home access)?"

A combination of non-probability convenience sampling and Judgmental sampling (purposive sampling) approach was used. Convenience sampling selects cases based on their availability and willingness to participate in the study (Palinkas et al., 2015). A Judgment sampling approach was used as the researchers had to rely on logic and judgment to pick the sample population (Palinkas et al., 2015). The sample size was that of 100 responses.

The survey questionnaire was distributed using the online survey tool Qualtrics. The link to the Qualtrics questionnaire was sent via email and on social media in order to target the required population. The emails were sent to mostly university students in the Cape Town as it can be assumed that a large number of digital natives can be found on a university campus. The universities were randomly chosen.

Data analysis methods

Once the data gathering period was concluded the data was extracted from Qualtrics and imported into the statistical analysis software Statistica for basic statistics tests that summarised and described the characteristics of the data gathered. Before being imported, the data was cleaned and coded in Excel in order to ensure it was free of errors and was analysable.

Reliability and item analysis was done using Cronbach's alpha tests. The relationships between the independent and dependent variables were found using Spearman Rank Order correlation analysis and multiple regression analysis tests.

DATA ANALYSIS

The findings are presented in this section. First, the reliability and consistency of the model was tested through the Cronbach's Alpha test. The data was then tested for normality. A descriptive tests analysis of the data was also conducted. The hypotheses were tested using correlation and multiple regression tests based on the normality of the data. Correlation analysis measured the strength of the relationships between variables whereas regression estimated what the relationship was (Saunders, Lewis, & Thornhill, 2009).

RELIABILITY TESTING

Cronbach's alpha tests were performed for each of the constructs (i.e., Perceived Benefits, Types of Data Collected, Awareness and Perceived Control) and were used to measure the internal consistency of responses pertaining to each construct (Bhattacherjee, 2012). A Cronbach's alpha of at least 0.6 is normally required (Bhattacherjee, 2012). Initial results of the Cronbach's Alpha test are shown in Table 2.

Table 2. Cronbach's Alpha Reliability Test Results

Construct	Cronbach's alpha
Perceived Benefits	0.45
Awareness	0.81
Types of data collected	-0.46
Perceived Control	0.72

As can be seen in Table 2, the Cronbach's Alpha values for the Awareness and Perceived Control constructs were acceptable (i.e., > 0.6). This was not the case for the Perceived Benefits and Types of Data Collected constructs. Further investigations into the results for the Perceived Benefits construct, showed that the second question on benefits (*I consider better distribution of city resources such as water, and electricity a benefit of living in a smart city*) had to be omitted so that the Cronbach's alpha for that construct could increase to 0.58 (approx. 0.6).

The negative Cronbach's Alpha result for the Types of Data Collected construct was due to having two similar questions which were inversely formulated:

1. I do not mind it when Cape Town uses data that specifically identifies me in the running of the city,

and

2. I do not mind it when Cape Town uses data about me if it does not specifically identify me (impersonal data/unidentifiable data).

The first question was omitted resulting in a Cronbach's Alpha result of 0.6 for the construct.

An overall instrument's reliability was then tested to assure the reliability and consistency of the instrument as a whole and produced a Cronbach's Alpha of 0.9 and a standardised alpha value of 0.9. Table 3 shows the final results of the Cronbach's Alpha tests performed for each construct and for the overall instrument's reliability after relevant questions were removed from the model.

Table 3. Final Cronbach's Alpha Reliability Test Results

Construct	Cronbach's alpha
Perceived Benefits	0.6
Awareness	0.9
Types of data collected	0.6
Perceived Control	0.7
Overall instrument's reliability	0.8

TEST FOR CONSTRUCT NORMALITY AND DISTRIBUTION

Each construct was tested for normality using the Shapiro-Wilk's (SW) and Kolmogorov-Smirnov. With a $p - value < 0.001$, the SW test is statistically significant for the test items in the constructs. Consequently, all the constructs are non-normally distributed.

DESCRIPTIVE TESTS

63% of the participants were female, 34% were male, and 3% chose not to disclose their gender. In addition, the participants consisted of digital natives from Cape Town born between 1985 and 1995. Most of the participants (77%) were born between 1991 and 1995 and 23% between 1985 and 1990.

HYPOTHESES TESTING

Since the objective of this study is to assess the relationship between the independent variables Perceived Benefits, Types of Data Collected, Awareness, and Perceived Control on the dependent variable (i.e., Level of Privacy Concerns), Spearman correlation tests were first conducted. The value obtained from the Spearman correlation test is called the correlation coefficient (Saunders, Lewis, & Thornhill, 2009). A positive correlation coefficient indicates a positive relationship between the two variables, while negative correlation coefficients indicate a negative relationship (Saunders et al., 2009). The closer the Spearman value is to ±1 the stronger the monotonic relationship between the variables (Saunders et al., 2009). The Spearman correlation test is useful for this study as it can be used on data that comes from Likert Scale variables and can be used for data that is non-parametric (Saunders et al., 2009).

Multiple regression analysis was also employed. Multiple regression analysis was used to determine the probability of the relationship between each individual independent variables and the dependent variable "Levels of Privacy Concerns" occurring by chance (Saunders et al., 2009).

H1: The more digital natives perceive to receive benefits from providing personal data to the smart city of Cape Town, the lower their privacy concerns.

As can be seen in Table 4, no support can be found for Hypothesis 1 as there is no statistically significant negative correlation between the Level of Privacy Concerns of Cape Town smart citizens and the two of the questions related to Perceived Benefits (Q3: 0.43, Q4: 0.38). Only Question 1 on Perceived Benefit has a negative correlation with Level of Privacy Concern (Q1: -0.23).

Table 4. Spearman's Rank Order Correlations: Perceived benefits and Levels of Privacy Concerns

	Spearman Rank Order Correlations MD pairwise deleted Marked correlations are significant at p <.05000		
Variable	**Benefit Q1**	**Benefit Q3**	**Benefit Q4**
Level of Privacy Concern	- 0.23	0.43	0.38

Moreover, the results of multiple regression analysis revealed an R value of 0.50. The degree of correlation is therefore moderate, and only 25.5% of the total variation in the dependent variable Levels of Privacy Concerns can be explained by the independent variable Perceived Benefits. Hence, the study indicates that Perceived Benefits does not significantly influence the levels of privacy concerns of digital natives living in the smart city of Cape Town.

This result is not in line with the findings of other studies such as those in the van Zoonen (2016) study on informational privacy concerns. These results are also in contrast to the theory concepts of "Price of Convenience (POC)" talked about in the literature review of this paper.

H2: The more impersonal the data being collected by the smart City of Cape Town, the lower the privacy concerns of the digital natives

As can be seen in Table 5, there is a signification negative correlation between the Type of Data Collected and the Level of Privacy Concerns in support of Hypothesis 2(Q1: -0.41) at 95% confidence level.

Table 5. Spearman's Rank Order Correlations: Type of data collected and Levels of Privacy Concerns

	Spearman Rank Order Correlations MD pairwise deleted Marked correlations are significant at p <.05000
Variable	**Impersonal Data Q2**
Level of Privacy Concern	-0.41

The results of the regression analysis also revealed that the more impersonal data is collected by the Smart City of Cape Town, the lower the privacy concerns of the digital natives. An R value of -0.39 was obtained indicating that the association is inversely correlated. The "types of data collected" construct shows a statistically significant correlation of a confidence level of 0.00007 (>99%).

The research findings of this study therefore indicate that the more digital natives felt that impersonal data was being collected by the smart City of Cape Town, the lower their privacy concerns. This is consistent with research findings from the van Zoonen (2016) study.

H3: The more control digital natives perceive to have control on the data collected about them by the smart city of Cape Town, the lower their privacy concerns

The results from Table 6 indicate that no support can be found for Hypothesis 3 as there is no statistically significant negative correlation between the Level of Privacy Concerns of Cape Town digital natives and three of the questions related to Perceived Control (Q2: 0.06, Q3: 0.86, Q4: 0.86). Only Question 1 on Perceived Control has a negative correlation with Level of Privacy Concern (Q1: -0.01).

Table 6. Spearman's Rank Order Correlations: Perceived control and Levels of Privacy Concerns

	Spearman Rank Order Correlations MD pairwise deleted Marked correlations are significant at p <.05000			
Variable	**Control Q1**	**Control Q2**	**Control Q3**	**Control Q4**
Level of Privacy Concern	-0.01	0.06	0.86	0.86

The results of the regression analysis also indicate that the variable Perceived Control does not significantly influence the levels of privacy concerns. In particular, a R value of 0.10 and a positive B coefficient of 2.41 was obtained.

Hence, the findings indicate that there is no statistically significant negative correlation between Perceived Control and the level of privacy concerns of digital natives living in the smart City of Cape Town. This result is different from those of other international studies (e.g., Beldad (2011). This difference might be explained by the practiced African philosophy of Ubuntu. Ubuntu places the rights afforded to a person as being determined not only by the individual person but largely by the community he or she lives in. This entices an individual to not put an importance on having control of what information is known about them or how it is used (Anteneh et al., 2015).

H4: The more the digital natives are aware of how their personal data is collected by the smart city of Cape Town, the lower their privacy concerns

Table 7 indicates that no support can be found for Hypothesis 4 as there is no statistically significant negative correlation between the Level of Privacy Concerns of Cape Town digital natives and all of the questions related to awareness of the method of data collection (Q1: 0.004, Q2: 0.020, Q3: 0.86).

Table 7. Spearman's Rank Order Correlations: Awareness of Method of Data Collection and Levels of Privacy Concerns

	Spearman Rank Order Correlations MD pairwise deleted Marked correlations are significant at p <.05000	
Variable	**Awareness Method Q1**	**Awareness Method Q2**
Level of Privacy Concern	0.004	0.02

The results of the regression analysis also indicate that the Awareness of Data Collection Method does not significantly influence the levels of privacy concerns. In particular, a R value of 0.09 and a positive B coefficient of 2.08 was obtained.

Results from the test carried out on this hypothesis, therefore, indicate that the test item does not show a statistically significant correlation to the dependent variable of Levels of Privacy Concerns of digital natives living in the smart City of Cape Town. This result is different from those of international studies (e.g., Beldad (2011)) and could possibly also be explained by the African philosophy of Ubuntu. In the widely adopted African philosophy of Ubuntu, whether or not an individual has an awareness of what rights pertain to them as a person does not influence the actual rights that are afforded to them as an individual (Antenehet al., 2015).

H5: The higher the need to be aware of the security measures put in place during the collection and storage of their personal information by the smart city of Cape Town, the higher their privacy concerns of the digital natives

As shown in Table 8, support could be found for Hypothesis at a 95% confidence level. The table shows that there is a statistically significant positive correlation between the Level of Privacy Concerns of Cape Town digital natives and all of the questions related to the need to be awareness of security measures put in place during data collection (Q1: 0.22, Q2: 0.72).

Table 8. Spearman's Rank Order Correlations: Awareness of Security Measures and Levels of Privacy Concerns

	Spearman Rank Order Correlations MD pairwise deleted Marked correlations are significant at p <.05000	
Variable	**Awareness Security Q1**	**Awareness Security Q2**
Level of Privacy Concern	0.22	0.72

The results of the regression analysis also revealed that the digital natives' need to be aware of the security measures positively significantly correlates to the levels of privacy concerns of living in a smart city at a confidence level of 87%. In particular, an R value of 0.32 and a positive B value of 1.98 were obtained.

Since the correlation between the dependent and independent variables is a positive one, the more the respondents placed an importance on knowing the security measures put in place in the collection and storage of data collected about them, the higher their privacy concerns. This is in line with other international studies (e.g., Stewart & Segars, 2002).

DISCUSSION

The study was conducted using a positivist and quantitative approach and five hypotheses were tested. Of these five hypotheses, only two were shown to have statistical significance as shown in Table 9.

The findings reveal that the more impersonal data is collected by the Smart City of Cape Town, the lower the privacy concerns of the digital natives. This is in line with van Zoonen (2016) who also found that the collection of impersonal data illicits low levels of privacy concerns, given the type of data that is being collected (e.g., gender, language spoken etc.).

The findings also show that the digital natives of Cape Town have higher privacy concerns when their need to be aware of the security measure put in place by the city is high. This is in line with past studies which also found that people's uncertainties regarding how their personal data is used and processed often triggers feeling of information privacy violations (Weltevrede, 2011).

Table 9. Hypotheses Results

Hypothesis	Result
H1: The more digital natives perceive to receive benefits from providing personal data to the smart city of Cape Town, the lower their privacy concerns.	Rejected
H2: The more impersonal the data being collected by the smart city of Cape Town, the lower the privacy concerns of the digital natives.	Accepted
H3: The more control digital natives perceive to have control on the data collected about them by the smart city of Cape Town, the lower their privacy concerns	Rejected
H4: The more the digital natives are aware of how their personal data is collected by the smart city of Cape Town, the lower their privacy concerns	Rejected
H5: The higher the need to be aware of the security measures put in place during the collection and storage of their personal information by the smart city of Cape Town, the higher their privacy concerns of the digital natives	Accepted

In the study Hypothesis 1 was rejected. This is not in line with past studies which found that people are willing to accept risks and disclose information when they perceive more benefits than risks in doing so (Beuker, 2016; Barth & de Jong, 2017). Hypotheses 3 and 4 were also rejected, in contrast to what has been said in literature (Beldad, 2011; Stewart & Segars, 2002).

Possible reasons as to why these hypotheses were rejected might relate to the philosophy of Ubuntu and other cultural beliefs that have rendered privacy concerns not as crucial or central to one's life in Africa, as compared to Western Cultures (Borena et al., 2015). Furthermore, it has been stated in literature that what data is deemed as private and sensitive varies from person to person, based on one's own cultural and societal definition of privacy (Alashoor et al., 2016; Taddicken, 2014).

It is important to understand the privacy concerns of the digital natives because, in a world that is more and more driven by sophisticated technologies, it can be argued that these digital natives are best able to navigate and use these technologies in the future. Cities need the technologically wise and

experienced to define, discuss, and evaluate the impact of different technologies in our societies in terms of ethics and liabilities (Prensky, 2009). In addition, cities should also consider the concerns of digital natives because recent history has shown that digital natives have been known to use their technological abilities to drive movements and unrest for change in the cities, which has now been coined as digital activism (Weltevrede, 2011).

This study contributes to scientific literature by detailing the impact of specific factors on the privacy concerns of citizens living in an African city. For city law makers in Cape Town, this study has practical implications as it provides information on relevant focus areas on which the law makers could pay attention to, with the aim to encouraging and appeasing any apprehensions from its citizens towards smart city implementations.

While these study's findings add to the body of knowledge, there were, however, limitations in the findings. Most of the participants in the study were university students, and a wider net should have been cast on finding participants. The sample size in future similar studies should be bigger. Income bracket, work industry, race, and gender are some of the attributes which were not taken into consideration in this study and should be taken into consideration in future similar studies.

CONCLUSION

Past studies indicate that there are four main factors that influence the privacy concerns of citizens living in smart cities. These factors are Awareness, Perceived Benefits, Types of Data Collected, and Perceived Control. However, these studies have mostly been conducted in developed countries and little is known about their impact in emerging smart cities in developing countries. This study investigated the impact of Perceived Benefits, Type of Data Collected, Perceived Control, and Awareness on the Level of Privacy Concerns of digital natives living in Cape Town, South Africa.

Only two of the five hypotheses were shown to have statistical significance. For the purpose of delving deeper into the reasons why some of the hypotheses could not be proven, it would be useful to make use of open ended questions. The open ended questions could be implemented through a mixed method research approach that would allow for an in-depth exploration on how the independent variables in this study influence the dependent variable. The use of open ended questions in a qualitative study could also be used to further identify other factors that might influence privacy concerns of digital natives living in the smart city of Cape Town.

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APPENDIX - QUESTIONNAIRE

A smart city is a city that incorporates the use of Information communication technologies (ICT) and the internet of things, in the managing and monitoring of city resources. A smart can use several technologies such as surveillance cameras and smart energy consumption meters in the running of the city. The concept of smart cities is used in various city management areas such as public safety, infrastructure design and infrastructure monitoring.

Data is constantly being produced and consumed in smart cities, data such as vehicle movements, visitor movements, energy consumption, neighbourhood sentiments and crowd control data. Data from different sources in smart cities is often integrated together in the aim of gaining a picture of the city's status in terms of safety, economic vitality and in terms of city resources usage.

Where you born between the years of 1985 to 1995	Yes	No
Please indicate your age		
Please indicate your gender	Male	Female
Do you have a place of residence in the city of Cape town?(You do not have to own the residence and can be renting or living with family or in university residence)	Yes	No
Did you have access to a computer/ and or internet during your primary school years? (access of this can come from anywhere, and is not limited to home access)	Yes	No

Benefits					
Kindly indicate the extent to which you agree or disagree with the following statements	Strongly disagree	Disagree	Both Agree and Disagree	Agree	Strongly agree
1. I consider better city service delivery a benefit of living in a smart city. 2. I consider better distribution of city resources such as water, and electricity a benefit of living in a smart city. 3. I believe that smart city initiatives will threaten rights to privacy. 4. I believe that smart city initiatives will negatively affect people's rights to confidentiality.					

Types of data collected					
Kindly indicate the extent to which you agree or disagree with the following statements	Strongly disagree	Disagree	Both Agree and Disagree	Agree	Strongly agree
5. I do not mind it when city of Cape Town uses data that specifically identifies me in the running of the city. 6. I do not mind it when the city of Cape Town uses data about me if it does not specifically identify me (impersonal data/unidentifiable data).					

Control					
Kindly indicate the extent to which you agree or disagree with the following statements	Strongly disagree	Disagree	Both Agree and Disagree	Agree	Strongly agree
7. I need to have control over what data is collected about me by the city of Cape Town. 8. I need to have the option of being able to opt out of data being collected about me by the city of Cape Town. 9. I need to have control over the technologies used to collect data about me by the city of Cape Town 10. I need to have control over how data is collected about me by the city of Cape Town					

Awareness (Methods of data Collection)					
Kindly indicate the extent to which you agree or disagree with the following statements	Strongly disagree	Disagree	Both Agree and Disagree	Agree	Strongly agree
11. Being aware of how data about me is collected by the city of Cape Town is important to me. 12. Being aware of what technologies are used in the collection of data about me by the city of Cape Town is important to me.					

Awareness (Need to be aware)					
Kindly indicate the extent to which you agree or disagree with the following statements	Strongly disagree	Disagree	Both Agree and Disagree	Agree	Strongly agree
13. Knowing how the data collected about me by the city of Cape Town is distributed to other departments in the City of Cape Town and other entities is important to me. 14. Knowing how the data that is collected about me is used by the city of Cape Town is important to me.					

Privacy concerns					
Please rate your level of privacy concerns in the following scenarios, 5 being very concerned and 1 being no concern.	1	2	3	4	5
15. The city of Cape Town collects personal data (identifiable data) about me. 16. The city of Cape Town collects impersonal data about me (non-identifiable data). 17. My personal data is collected by the city of Cape Town and is used for bettering city management, city planning, enhancing city services and providing better support to local citizens. 18. I am aware of who, and/or what is collecting data about me in the City of Cape Town. 19. The method of data collection by the City of Cape Town involves surveillance and specifically identifies individuals. 20. The method of data collection by the city of Cape Town involves surveillance but does not specifically identify individuals. 21. When I am aware of the methods used in the collection of data on me by the city of cape town. 22. When I am aware of how data collected about me by the city of Cape Town is used. 23. When I feel that I have control over what data is collected about me by the city of Cape Town. 24. When I feel I have control over how data is collected about me by the city of Cape Town. 25. When I feel I have control over how much data is collected about me by the city of Cape Town 26. When I am aware of how data collected about me by the city of Cape Town is shared among departments in the city of Cape Town and with external entities. 27. When I do not know the security measures put place in the collection and storage of my personal data by the City of Cape Town. 28. When I know the accuracy of the data collected about me by the city of Cape Town. 29. When I know who has legitimate access to the personal information collected about me by the City of Cape Town.					

BIOGRAPHIES

Valerie Tshiani completed a BCom (Honors) in Information Systems at the University of Cape Town in 2017. She also completed a B.Sc in Computer Science and Business Computing in 2015. Her research interests are related to issues around Smart Cities implementations and quantitative studies.

A/Prof Maureen Tanner has been teaching systems analysis and design at the Department of Information Systems of the University of Cape Town since 2009. Her research interests lie in Social Media, Agile software development related issues (for both collocated and distributed teams), UML, software engineering and social aspects of social engineering, global software development, virtual teams, and team collaboration.