Received: 22 May 2022 | Revised: 29 August 2022 | Accepted: 14 October 2022

DOI: 10.1111/tgis.13003

RESEARCH ARTICLE

Transactions in GIS WILEY

Qualitative insights into the acceptance of QGIS in South Africa

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Abstract

We conducted a study to find out whether and why South African users accepted QGIS. In the quantitative part of the study, we found that QGIS acceptance is primarily influenced by habit, followed by facilitating conditions, price value, and social influence. To better understand and explain these results, we conducted a qualitative study in which semi-structured interviews were conducted with 12 geospatial practitioners. While a geographic information system (GIS) product was often prescribed by their workplace, interviewees had clear preferences for a specific GIS product for certain kinds of tasks, supporting the finding that habit is the main reason for using a GIS product. Interviewees used QGIS because it opens most data formats and there is one license for all functionality (facilitating conditions), is free (price value), and/or had been advised by someone important (social influence). The interviews revealed why software support (commercial or free) was not significant in the quantitative results: users think GIS support is not necessary or else available online. Identical to the quantitative study, interviews confirmed that customizability, no vendor lock-in, improved reliability, quality, and security do not play a role when deciding to use QGIS. These qualitative results provide a deeper understanding of the quantitative results and can be used by promotors of open-source geospatial software to increase uptake. In general, they can also

help managers embed new products into any organization's workflows. In our study, interviewees and questionnaire respondents were selected to be users. Repeating the study for GIS developers and/or managers will provide further insight into QGIS acceptance.

1 | INTRODUCTION

Today, geospatial information plays a wide ranging and crucial role in society across many sectors, including government, research and development, the military, and civilian companies (Avand & Moradi, 2021; Fletcher-Lartey & Caprarelli, 2016; Landres, 2001). In the distant past, a small number of geographic information system (GIS) products was accessible to selected expert users. Over the past two decades, this has expanded into a range of products available for many different purposes and kinds of users, including free and open-source software for geographical information systems (FOSSGIS). Several benefits are attributed to FOSS, including cost, support from a large global community of developers and users, transparency because one has access to the source code, quality, reliability, improved security because of thorough code reviews, customizability, and no vendor lock-in (Bridge, 2017; Bromhead, 2017; Noyes, 2010; Wheeler, 2015). Apart from these, the faster turnaround of the FOSS development cycle presents benefits for software developers and users (Hall & Leahy, 2008), allowing continuous improvement and rapid development of FOSS products. In the case of FOSSGIS, the developers of the software are often also the users (Sutton, 2018).

Despite the advantages that FOSSGIS has to offer, in South Africa the adoption of QGIS, globally the most widely used FOSSGIS, has been relatively slow (Coetzee et al., 2018). The results of a survey in 2015 among geospatial professionals in South Africa showed that proprietary platforms are used most of the time, but there were also signs of an increase in the use of FOSSGIS—only 14% of respondents had never used FOSSGIS (Coetzee et al., 2018). Another study showed that users involved in military operations had the perception that QGIS was not mature enough for their purposes (Henrico et al., 2020). We wanted to find out the reasons for this and therefore conducted a study to understand the acceptance and use of QGIS in South Africa.

The extended unified theory of acceptance and use of technology (UTAUT2) model was adapted for our study (Henrico et al., 2021). In 2019, just over 200 members of the Geo-Information Society of South Africa (GISSA) completed a questionnaire structured according to the UTAUT2 model. The results of this quantitative part of the study were published in two articles. The first showed that habit, facilitating conditions, price value, and social influence had the most significant influence on users' behavioral intention to use QGIS. That is, users who have never used QGIS are also unlikely to use it in future because of their habits based on past behavior (Henrico et al., 2021). The second article showed that age and gender had no moderating effect on any of the tested variables. However, GIS experience moderated the effect of social influence and facilitating conditions; educational level moderated the effect of price value; and professional registration with the South African Geomatics Council (SAGC) moderated both social influence and price value (Henrico et al., 2022). To get a richer understanding of these quantitative results, we conducted semi-structured interviews with geospatial practitioners in South Africa. The results of this qualitative part of the study are presented in this article.

The outline of the article is as follows: in Section 2, the research model is presented; in Section 3 the method is discussed; the results of the qualitative data analysis follow in Section 4; Section 5 discusses the results and Section 6 concludes.

2 | RESEARCH MODEL

The UTAUT2 model, widely used to test technology acceptance (Abdellah et al., 2016; Alalwan et al., 2017; Arenas Gaitán et al., 2015; Henrico et al., 2021; Morosan & Defranco, 2016), was adapted for our study by adding

TABLE 1 Constructs in the adapted UTAUT2 model

Construct	Definition
Performance Expectancy (PE)	"The degree to which a person believes that a particular system will help to attain advances in job performance" (Venkatesh et al., 2016)
Effort Expectancy (EE) (Ameen & Willis, 2018)	"The degree of ease associated with consumers' use of technology"(Venkatesh et al., 2012)
Social Influence (SI) (Chang et al., 2019)	"The degree to which an individual perceived that important others believe he or she should use the new system" (Venkatesh et al., 2003)
Hedonic Motivation (HM)	"The fun or pleasure derived from using a technology, and it has been shown to play an important role in determining technology acceptance and use" (Venkatesh et al., 2012)
Price Value (PV)	"Consumers' cognitive trade-off between the perceived benefits of the applications and the monetary cost for using them" (Venkatesh et al., 2012)
Habit (H)	"The extent to which people tend to perform behaviors automatically because of learning" (Venkatesh et al., 2012)
Facilitating Conditions (FC)	"The consumers' perception of available support when using the consumer system" (Venkatesh et al., 2016)
Behavioral Intention (BI)	"The individual willingness to use and continue to use a technology, and the factor that determines the usage of a technology" (Miladinovic, 2016)
Source Code (SC)	"The ability to use, share, develop and contribute source code to the software" (Henrico et al., 2022)
Software Support (SS)	"The availability of technical support for the products" (Henrico et al., 2022)

two constructs, source code (SC) and software support (SS), and two moderators, educational level and SAGC registration. The definitions of the constructs of this adapted model are presented in Table 1, while Figure 1 shows the nine hypotheses (H1–H9) of the study based on the adapted UTAUT2 model in Venkatesh et al. (2012). In the figure, the constructs and moderators we added for our study are shaded in gray. For the qualitative study presented in this article, we based questions in the semi-structured interviews on the constructs in this adapted UTAUT2 model.

3 | METHOD

3.1 | Semi-structured interviews

In this study, semi-structured interviews were used to collect qualitative data. In all, 12 participants were purposely selected to take part in the interviews. They were chosen to represent geospatial practitioners from a variety of state departments, the private sector, and the educational sector. All the participants were active GIS users, but not involved in GIS procurement decisions. Five of them were registered with the SAGC. We invited interviewees without knowing whether they were active QGIS users or which software they used in their respective workplaces. From the interviews, it became clear that six interviewees (participants 2, 3, 4, 7, 9, and 10) only used proprietary software at the workplace, even though they had access to both proprietary and QGIS; two interviewees (participants 5 and 6) only used the proprietary software prescribed for them by the workplace; however, participant 6 indicated that QGIS was used occasionally at home; and four participants used QGIS for all their GIS tasks

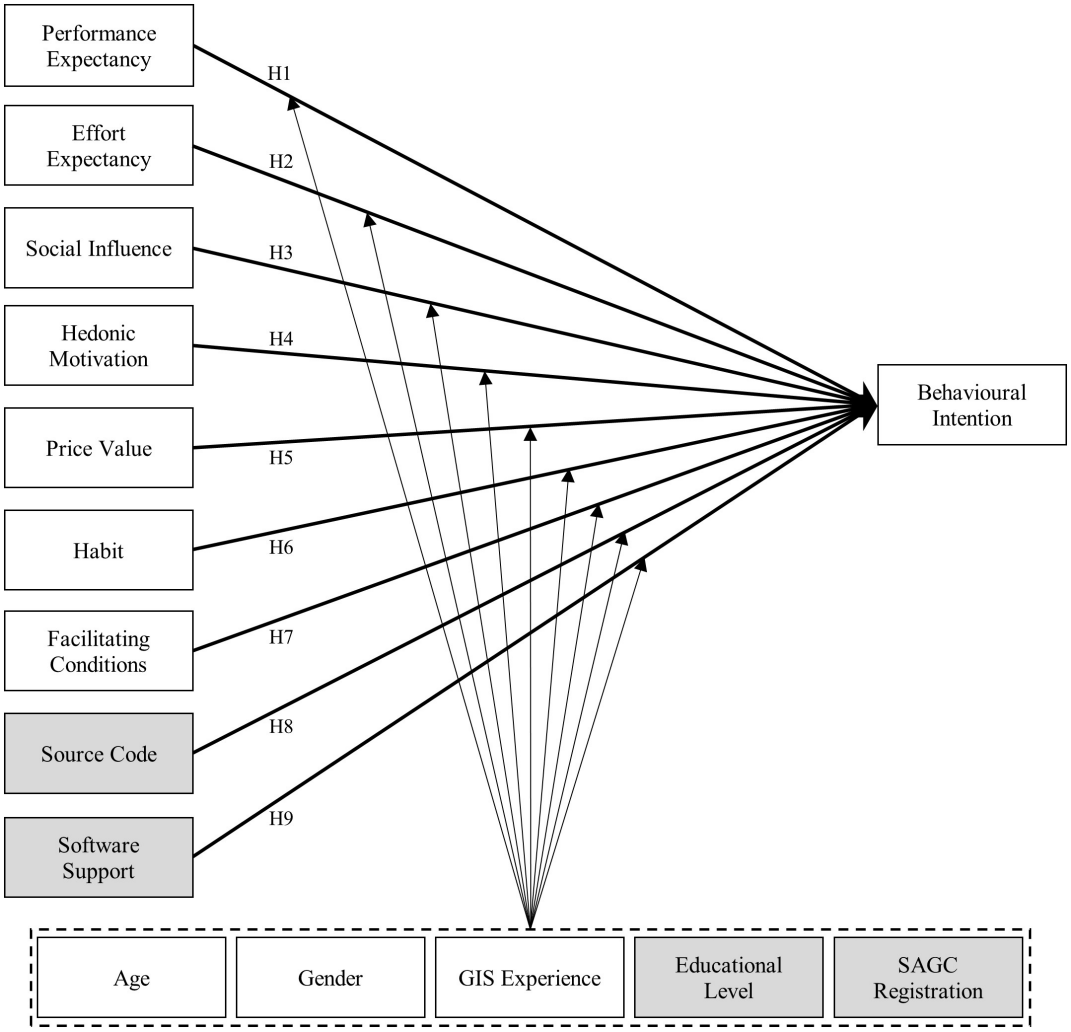

FIGURE 1 Hypotheses for our study based on the adapted UTAUT2 model in Venkatesh et al. (2012). *Source*: Henrico et al. (2021).

(participants 1, 8, 11, and 12). The interviews were guided by the questions in Table 2. The first column shows the construct from the adapted UTAUT2 model, and the second the questions for each construct. These questions relate to questions asked in the original quantitative survey. The interviews were of a semi-structured nature and the participants were asked to elaborate and provide reasons for their answers. All participants responded to all questions in the interview guide.

The Otter mobile application (Otter.ai, 2020) was used to record and transcribe the interviews. Automatically prepared transcripts were reviewed and corrected by repeatedly listening to the recorded interviews.

3.2 | Research ethics

Ethical approval for this study was obtained from the Research Ethics Committee of the Faculty of Humanities at the University of Pretoria (HUM 018/0119). A consent form was handed to each participant, informing them about the goals of the study and stating their rights. Participants gave consent to participate in the study by signing the form.

TABLE 2 Questions for the semi-structured interviews

Constructs	Item
Performance expectancy	1. Do you find QGIS useful in your daily life?
	2. Does QGIS help you to accomplish GIS tasks more quickly?
	3. Does QGIS increase your productivity?
	4. Do you feel that QGIS increases your performance because you have access to more advanced functionalities?
Effort expectancy	5. Is it easy to find training material for QGIS?
	6. Is it easy to become skillful at using QGIS?
	7. Overall, do you find QGIS easy to use?
Social influence	8. Do people whose opinions you value prefer that you use QGIS?
	9. Do people who are important to you think that you should use QGIS?
Hedonic motivation	10. Is using QGIS fun?
	11. Do you think that QGIS is a user-friendly product?
	12. Do you think that using QGIS is entertaining?
Price value	13. Do you think that QGIS is good value considering that it is free?
	14. Do you use QGIS because it is free?
	15. Do you think that QGIS is good value despite the fact that it is free?
Habit	16. Has using QGIS become a habit for you?
	17. Has using QGIS when viewing data become a habit for you?
	18. Has using QGIS when digitizing become a habit for you?
	19. Has using QGIS to do analytical tasks become a habit for you?
Source code	20. Do you use the QGIS source code to understand how the software works?
	21. Do you use the QGIS source code to customize the product for your own purposes?
	22. Do you contribute to the QGIS source code to improve the product?
Facilitating conditions	23. Is QGIS compatible with other geospatial technologies you use?
	24. Is QGIS compatible with all the data you use?
	25. Is QGIS compatible with the geospatial databases you use?
Software support	26. Is the software support for QGIS products good?
	27. Is the software support for QGIS expensive?
	28. Do you know who to contact when you need software support for QGIS?
	29. Do constantly need face-to-face software support for your GIS work projects?
	30. Is software support that the internet offers (blogs, online manuals, videos and tutorials, etc.) in terms of QGIS more than enough for you?
Behavioral intention	31. Do you intend to start using QGIS in the future?
	32. Do you always try to use QGIS in your daily work?
	33. Do you intend to continue to use QGIS in the future?

4 | DATA ANALYSIS AND RESULTS

The results of the qualitative data analysis are presented in relation to each of the constructs of the adapted UTAUT2 model, supported and validated by direct quotes from participants in Tables 3–12. The quotes are summarized in the text. The question numbers in the tables correspond to the question numbers in Table 2 (the interview guide) and a letter was assigned to each quote for referral purposes, for example, the first question of the interview guide was,

"Do you find QGIS useful in your daily life?" and one of the responses was numbered 1c, "Yes, I think it's very useful because it's an open source. Then you can use it everywhere, wherever you are".

The quotes were selected to illustrate the diversity in opinions and to provide insight into the quantitative results: some responses were unexpected; in other cases, they provide the extremes of the responses, or they help to explain the statistical results. Although the software support construct was eliminated during model analysis of the quantitative study, we included it in the qualitative study to better understand why it was irrelevant.

4.1 | Performance expectancy

Responses revealed strong preferences for a specific product, either for QGIS (responses 1a and 1b) or for another GIS product (responses 1e and 1f). For example, participant 1 indicated that it was difficult to work without QGIS and that it was essential, since it was the only GIS software used by the participant (response 1d). A reason for not using QGIS was that corporate GIS software is prescribed by the employer and that participants therefore felt that they were compelled to use the product provided by the employer. In other words, they did not consider performance when choosing to work with a specific GIS product (response 1 g). Reasons for QGIS preference included the following: participant 4 felt that it was useful because since it was open source it could be taken anywhere (response 1c); participant 11 felt that it was useful because it allowed access to all the advanced tools for free and that they did not have to acquire different license levels (response 2b and 4a); and participant 12 mentioned that they did not have access to other GIS software and that QGIS was therefore used by default (response 1d).

TABLE 3 Questions and examples of responses related to performance expectancy

1. Do you find QGIS useful in your daily life?
a. Yes, I actually cannot work without QGIS
b. … QGIS is only one I use
c. Yes, I think it is very useful because it is an open source. Then you can use it everywhere, wherever you are
d. … whenever I need to do anything GIS my default would be to go to QGIS
e. … not very big on using QGIS
f. I do not really use QGIS in my daily life
g. I do not use it in my daily life because we use GeoMedia
2. Does QGIS help you to accomplish GIS tasks more quickly?
a. Well, it helps me to accomplish tasks, stop
b. Yes, with the stuff I cannot get done in Esri because of license stuff
c. … so, I would not say it is more quickly because, that is my only tool that I use to do GIS
d. No, because I do not use it. I do not use it on daily basis
e. … I think is more complicated to use especially if you are not familiar it and if you did not get training …
3. Does QGIS increase your productivity?
a. … it does increase my productivity
b. Yes, it does. If you use it every day
c. Absolutely, absolutely. So, I would not be able to work essentially
d. I'm not very well versed in it
e. I will say, no
f. … if you just use it for a certain project. I do not recommend it
g. Compared to other GIS software. I think it is not user-friendly

TABLE 3 (Continued)

4. Do you feel that QGIS increases your performance because you have access to more advanced functionalities?
a. Yes, the fact that you can go into your Python library and install different other sets of tools …
b. Yes, I think it will be able to increase your performance because it has a couple of nice features that I found quite useful
c. No, I do not think so
d. I will say, no
e. … no, it does not because we do not fully implement it in the enterprise …
f. … the software that we do have it does have advanced functions in them. So, software that we bought to do accomplish tasks does do that what we need it to … we use it for viewing data

Opinions about whether QGIS helped users to accomplish GIS tasks more quickly varied (responses 2a, 2b, 2d and 2e). Reasons provided for QGIS not doing so included that they did not use it on a daily basis and therefore felt that their skill level was not of such a nature that they could accomplish GIS tasks more quickly in QGIS (response 2d). Participant 4 felt that QGIS was more complicated and difficult to use, especially without training (response 2e) and according to participant 3, when compared to other GIS software, QGIS was not user-friendly (response 3g). On the other hand, participant 1 said that it was his/her only tool and therefore felt it was quicker to achieve GIS tasks (response 2c).

Participants were divided about whether QGIS increased productivity (responses 3a, 3b, 3c, and 3e). However, most participants agreed that QGIS could increase productivity once a user became familiar with the software (response 3b). Participant 4 elaborated on this by saying that it would increase productivity if one used it regularly ("every day") and not only for a certain project (response 3f). Another response suggests that QGIS could increase productivity, since licensing restrictions prevented the person from doing certain tasks with proprietary software (response 2b). The responses reveal that familiarity with a specific product impacts productivity because they would not be very proficient in using alternative software such as QGIS (responses 3d and 3f).

Participants were divided about whether QGIS increased their performance (responses 4a, 4c, 4d, and 4e). Participant 5 said that the software they were using already had advanced functionalities and that they only used QGIS to view data (response 4f). However, participants 11 and 12 felt that QGIS increased their performance because of all the add-on tools one could get from the library (responses 4a and 4b).

4.2 | Effort expectancy

Most of the participants agreed that it was easy to find training material for QGIS (responses 5a, 5b, and 5c). They used the Internet to get whatever they needed and stated possible reasons for finding the material as the fact that open-source and associated forums can be easily found on the Web. However, participants 3 and 4 said that there was not enough training material for QGIS (response 5d). Participant 10 did not know, because no search was ever performed for any training material about QGIS, since the person did not use QGIS (response 5e).

All participants, except participant 3 (responses 6f and 6g), felt that it was easy to become skillful in using QGIS (responses 6b). Participant 2 said that the reason for this was that one had access to QGIS all the time (on one's tablet or laptop) because it was free (response 6c). Others reported the online videos and forums as reasons for the ease of becoming skillful in using QGIS (responses 6a and 6d). Participant 10 felt that the many functionalities that one can access, which are not available in other software products, makes it easy to become skillful in using QGIS (response 6e).

Generally, participants said QGIS was easy to use (responses 7a and 7b), especially if one was a GIS operator (response 7b). Participant 11 said that although QGIS was easy to use, the Python environment in QGIS was on such a high level that a "normal" GIS user would not understand it (response 7g). Some participants struggled to

TABLE 4 Questions and examples of responses related to effort expectancy

5. Is it easy to find training material for QGIS?
a. Its way easier to get material for QGIS …
b. … The training material is quite easy to find
c. Yes, you go on to the QGIS website and there is the cookbook and all the stuff
d. … No
e. With regards to training material, I do not think there is enough training materials. I never looked for actual material for QGIS
6. Is it easy to become skillful at using QGIS?
a. Yes, I think so it is also MOOCs
b. I would think so
c. … it can be on your laptop, on your tablet, on everywhere because it is free
d. I think it is because they are quite some videos that you can watch with regards to QGIS
e. There are some functionalities that you do not find in other GIS software that you can find in QGIS
f. I do not think QGIS is easy, I do not find it easy
g. I tried to use it, but I could not get a lot of the functions that you get in other software …
7. Overall, do you find QGIS easy to use?
a. Yes, it is a simple product
b. … it is easy to use QGIS if you are a GIS operator …
c. … overall, I would say it is an easy platform to use straightforward …
d. I think it is not very useful or easy to use
e. I do not think QGIS is easy, I do not find it easy
f. I think it is quite complicated …
g. I wanted to use Python in QGIS, and I found that the training material or the cookbook was, it was written for very high-level people with more IT background of the terminology, they were using terminology that the normal GIS person do not understand. I had to go research on this stuff, and it did not actually help …

find all the functions and features needed to do a task and thought that using QGIS was complicated (responses 7d, 7e, and 7f).

4.3 | Social influence

The interviews showed that social influence plays a significant role in the behavioral intention to use QGIS. Most of the participants agreed that people whose opinions they value preferred that they used QGIS (responses 8a, 8b, and 8c), some were ambivalent (responses 8e and 9d), while others were not influenced by others at all (response 9f). Participants were influenced by the opinions of their mentors, employers, technical support, lecturers and peers, and they also learned from these people (response 9a). For example, the main reason for using QGIS put forward by Participant 8 was because "those people referred [him/her] to QGIS" (response 8a). However, the switch from proprietary products to QGIS rarely happened. Participant 5 said that his/her managers probably thought it was a good idea to shift to using QGIS as cost-saving factor, but that there was reluctance to do so because they did not know whether QGIS could meet their requirements and the conversion of all their information systems to QGIS would be a difficult operation (response 9b). For participant 11, it did not matter what others thought, as long as the job got done (response 9c). Participant 2 felt that his/her work would seem less valid and of a poor quality if it were done using QGIS and for that reason would stick to using proprietary software (response 8d).

It was clear from the interviews that teaching QGIS at tertiary level could play a role in the future acceptance of the product. Participant 6 said that they were taught that QGIS was just as good as any other package and that the

TABLE 5 Questions and examples of responses related to social influence

8. Do people whose opinions you value prefer that you use QGIS?
a. I think the main reason why I am using QGIS, is because those people, referred me to do the package, so yes …
b. Probably yes, but I do think, if I can be arrogant, I probably influenced more people to use QGIS
c. … at Tech we were told that QGIS is just as good as any other package
d. I find that most people find your work, to be more valid when you use other software's that are bought, as opposed to the open-source software
e. I cannot say that, that people expect me to use it …
9. Do people who are important to you think that you should use QGIS?
a. I think the main reason why I am using QGIS, is because those people, referred me to do the package so yes, on both accounts
b. … he wants us to use it, so it was important for him to have a free and save money. So yeah
c. I do not think it really matters as long as you get the job done
d. I would say, no …
e. … most of the people that they asked about QGIS, said no …
f. In the institution where I function, the major users use ArcGIS. So, from them there is always, why do not you use ArcGIS and I think it is because they [are] used to ArcGIS, where I'm used to QGIS, and they would say, why not use ArcGIS, but I've become used to QGIS. So, I've never seen the necessity to change it

person was still using it today (response 8c). Participant 12 was influencing others to use QGIS (response 8b). For participants 1, 2, 3, 4, and 7 people important to them (especially their employers) preferred them to use proprietary software (responses 8d and 8e and 9c–9e). Participant 1 had become accustomed to QGIS but was always asked by other people why proprietary software was not used instead (response 9f). This response illustrates the significant impact of habit—although people who play an important role motivate the participant to use proprietary software, the person does not because they have "become used to QGIS."

4.4 | Hedonic motivation

When asked whether using QGIS was fun, some participants argued that they did not think that using QGIS was fun, mainly because it was used for work purposes. For these participants, "work" could not be perceived as "fun" (responses 10d and 10f). Other participants offered more reasons for this not being fun, for example, participants 4 and 9 felt that it was not fun to use since it was difficult to use and not user-friendly (responses 10e and 10g). However, participants 2, 8, 10, and 11 considered QGIS to be fun to use (responses 10a and 10c). Participant 5 found any GIS fun to use, not only QGIS (response 10b).

Some participants were of the opinion that QGIS was a user-friendly product (responses 11a, 11b, and 11c), or at least not or "not un-user friendly" (response 11e). Participant 11 said that if one played around in QGIS a little, one would find whatever one was looking for (response 11c). Other participants felt that QGIS was not a user-friendly product (responses 11d and 11e). One participant presented the add-ons in the graphical user interface (GUI) as the reason for QGIS not being user friendly (response 10g). Participant 8 felt that it took a bit of time to get used to all the software's quirks (response 11f), while participant 3 felt that compared to other GIS software, QGIS was not user-friendly (response 11g).

Opinions about QGIS being entertaining were divided. According to participants 1 and 7, anything results based and used for work purposes could not be entertaining (responses 10f and 12g). Participant 9 felt that it was not entertaining to use because they struggled with the GUI (response 12f), others did not provide a reason (responses 12d and 12e). One participant considered QGIS to be entertaining because it was a "nice tool" (response 12a), and another felt that any GIS was entertaining because it challenged one's mind (response 12b). Participant 4 thought that if they tried to use QGIS more often, it could become entertaining (response 12c).

TABLE 6 Questions and examples of responses related to hedonic motivation

10. Is using QGIS fun?
a. … it is very, it is fun
b. I would say any GIS software is fun to use
c. I think so, … it was fun playing around with …
d. I would not describe it as fun …
e. I do not really think it is fun because if something is complicated for you will not enjoy working on it
f. I do not use it for fun or entertainment I use it for my work …
g. QGIS is definitely not fun. It is not a friendly product for me because the GUI, for me it is difficult to have add-on's …
11. Do you think that QGIS is a user-friendly product?
a. It is quite user-friendly
b. Yes, it is user friendly
c. Yes, I do. Even if you play around a bit, you'll find whatever you are looking for
d. No, I do not think [it is] user friendly …
e. I would not necessarily call it user friendly, it is not un-user friendly …
f. … it takes a bit of time to get the hang of, of all [its] quirks
g. I could not get a lot of the functions that you get in other software. So, it is not easy to use
12. Do you think that using QGIS is entertaining?
a. I think this is … entertaining, it is a nice tool
b. Any GIS is entertaining. It challenges …
c. Maybe it can be entertaining if I try, then use it more often …
d. I would not see it as an entertaining tool …
e. No
f. Definitely not entertaining because the GUI is so confusing …
g. I would not see it as an entertaining tool because now it is a tool that is used to achieve results. So, when it is result based, I would not think it is there for entertainment

4.5 | Price value

All the participants agreed that QGIS was good value considering that it was free (responses 13a, 13b, 13c, and 13d). All of them were positive about the fact that such a good product with so many useful plugins was available for free. However, participant 4 felt that it was only of good value if one was not working on big projects.

Most participants stated that they used QGIS because it was free (responses 14a, 14b, 14c, 14d, and 14 e). Additional reasons stated include that it was easy to obtain and not complicated to set up (response 14d); that one could use it without having to subscribe (responses 14e and 14f); and that it was compatible with other software (response 14c). On the opposite end, one participant did not use QGIS because it is free (response 14g).

All participants agreed that QGIS was of good value despite being free (responses 15a, 15b, 15c, 15d, 15e, and 15f). Participant 12 stated that even if they had to buy QGIS, they would still be using it (response 15e). Participant 8 said that it was one of the best free software products they had ever used and that there were no usage restrictions on any of the features and functionalities (response 15f). Participant 11 felt that the support for QGIS was improving all over the world and that there were many positive developments (response 15g). Participant 5 reported that, although it was of good value, they still had to use their enterprise software in the workplace (response 15h).

TABLE 7 Questions and examples of responses related to price value

13. Do you think that QGIS is good value considering that it is free?
a. Yes, I'm sure it's good value …
b. I do I honestly feel like it is a very good software for a free software
c. Yes, I would have to say yes, I'm using it because it is free …
d. I'm using QGIS, because it's free, but at the same time it's a very good product
14. Do you use QGIS because it is free?
a. Yes, I would have to say yes …
b. Seeing that it is free and that's precisely the reason why I use it …
c. Yes, I would have to say yes, I'm using it because it is free, it does not require internet after I have installed it and everything on it, it's compatible with these other costly software's …
d. I'll use it, it's free and it's easy to get, it's not complicated to set up
e. It's good value, because you can download it from the internet without subscribing to any …
f. If I do not have a license to use something else, I'll use QGIS …
g. I do not use QGIS because it is free …
15. Do you think that QGIS is good value despite the fact that it is free?
a. Yes, I'm sure it's good value …
b. I do I honestly feel like it is a very good software for a free software
c. Yes, I would have to say yes, I'm using it because it is free …
d. I'm using QGIS, because it's free, but at the same time it's a very good product
e. If they charge money for it, I probably would have bought it as well
f. it is pretty much one of the better packages that I've used. I mean there's no, there's no limitations, there is no restrictions, it is for the features and functionalities. Definitely. It provides good value
g. … the community supporting QGIS is just becoming bigger and bigger …
h. Yes, I'm sure it's good value, okay, but we cannot depend on because we use enterprise at the moment

4.6 | Habit

Responses of participants were split in half about whether QGIS had become a habit for them (responses 16a–h). Participant 1 had used very few other tools (response 16a). For Participant 7, it had become a habit, since QGIS was the software used at home once they had left the office (response 16d). For Participant 8, it was difficult to say if QGIS had become a habit, but that they would definitely use it again. Participant 2, however, said that it was not a habit because they used ArcGIS (response 16g). According to Participant 3, it was too difficult to use QGIS and therefore it had not become a habit (response 17e), and for participant 5 QGIS was not a habit, because software prescribed by the department was used (response 16h).

For the majority of participants, viewing data in QGIS had become a habit. They agreed that QGIS' capability to view a variety of data formats was very good. Some stated that they used QGIS for this purpose only and not for digitizing and analyzing (responses 17a–g). Participant 11 used QGIS for viewing data, since it could handle different data formats better (response 17d). Participant 5 reported that even though they did not use QGIS often, their sales section used it frequently to view data. For participants 2, 3, 4, and 9 viewing data with QGIS had not become a habit because they preferred another product (response 17 g).

On the other hand, most participants indicated that digitizing in QGIS was not a habit (responses 18e–h). Even though participants 1, 5, and 11 used QGIS for visualizing data, they did not use it for digitizing (responses 18e–i). Participant 5, however, reported that some of the contractors working for their company used QGIS for data capturing. For participant 6, digitizing with QGIS had definitely become a habit. Participant 7 used QGIS for digitizing when out of the office (response 18d).

TABLE 8 Questions and examples of responses related to habit

16. Has using QGIS become a habit for you?
a. Yes, I mean I use very little other tools …
b. Yes, it is the product I use …
c. I definitely used QGIS above the other software packages …
d. I would have to say, yes, because now once I'm out of my office. That's the platform I use and, as I said, it's much more advantageous because both the platforms I'm using they can use the same data
e. No, it did not become a habit for me
f. Not for me …
g. Definitely no to all these questions, I prefer to use ArcGIS
h. QGIS has not become a habit for me to use because I'm using something that is paid for by the department
17. Has using QGIS when viewing data become a habit for you?
a. I use QGIS for visualizing data, yes
b. Yes, because it's sometimes just easier …
c. Yes, it is the product I use and I use it for viewing data a lot
d. Yes, because it's sometimes just easier, and it can I think it can handle the different data formats better than Esri
e. I only used it once, then it was complicated, then I did not use again
f. QGIS has not become a habit for me to use because I'm using something that is paid for by the department. But for example for viewing data it has become a habit …
g. Definitely no to all these questions, I prefer to use ArcGIS
18. Has using QGIS when digitizing become a habit for you?
a. … definitely has become a habit to use …
b. Definitely has become a habit …
c. I can use the very same data to view and analyze data from my home using QGIS
d. And then with the digitizing part of it, out of the office I use QGIS, in the office it is the other one
e. I cannot really say that it has
f. On all four of these questions, no …
g. Unfortunately, I have not really digitized in QGIS
h. Definitely no to all these questions, I prefer to use ArcGIS
i. … we [are] still using the enterprise GIS for the data capture
19. Has using QGIS to do analytical tasks become a habit for you?
a. I think to do analytical tasks, definitely
b. Yes, certain stuff I would rather do in QGIS because of licenses
c. I only used it once, then it was complicated, then I did not use again
d. I tend to do a little bit more of the analytical stuff elsewhere, but that's just because of how being taught …
e. … with regards to this habit. All the answers [is] no

Some participants preferred QGIS for analytical tasks (responses 19a and 19b), for example, participant 11 would rather perform analytical procedures in QGIS because it was sometimes easier to set up and carried no additional licensing expenses (response 19b). However, most of the participants agreed that they were not using QGIS for analytical tasks habitually (responses 19c–e). Participant 6 added that they tended to do the analytical tasks elsewhere (in other software) because of the way they had been taught (response 19d). Participant 2 used proprietary software for analytical tasks (response 19e).

4.7 | Source code

None of the participants were using QGIS for the ability to access and contribute to its source code. They indicated that they did not know how to do this and therefore did not customize or contribute to the product. This can be explained by the fact that we selected users for the interviews, not developers.

Responses revealed that the participants were not using source code to understand how the software works (responses 20a–e). Participant 12 said that they did not "mess around with the source code" (response 20e). Participant 5 was the only person to report that QGIS was used in his/her company to help with orthophoto mapping (response 20f). The remaining participants said that their organizations usually did not get involved in the programming side of GIS.

None of the participants used the source code to customize QGIS for their own needs. Participant 8 felt that there was no need to customize the product (response 21d). Participant 11 would love to but was just more comfortable with doing that in the proprietary environment that he/she knows (response 21e).

None of the participants indicated that they contributed to the source code to improve QGIS (responses 22a–d). Participant 11 wanted to but was struggling to do so (response 22e). Participant 8 was not contributing yet but might do so in future (response 22d). Participant 1 stated that they were not using QGIS for the source code and therefore did not contribute to it (response 22b).

TABLE 9 Questions and examples of responses related to source code

20. Do you use the QGIS source code to understand how the software works?
a. We did try one or two
b. No, I do not use for source code, and I do not contribute to programming …
c. No. Never. Never contributed or, I do not know that side …
d. No, I have not done anything on that part
e. I do not mess around in the source code
f. So, we got people to actually use the source code and they can map and style a map and see if we could use it for one in 10,000 orthophoto mapping
21. Do you use the QGIS source code to customize the product for your own purposes?
a. No, never done that before
b. I do not contribute to this code at all. I use it as it is
c. I think the source code is Python. So, I've got a little bit of background on Python, but I've never played with this before …
d. Okay, so no, on all three questions no. I did not have any reason to go and look at the source code …
e. I'm more equipped to do that in Esri environment, it's easier to set up there
22. Do you contribute to the QGIS source code to improve the product?
a. No
b. No, I do not use for source code, and I do not contribute to programming
c. I am sure those people in the office doing [those] does contribute back. Personally myself, no.
d. Not yet, but you never know what the future holds, so it might be something that, that I'll look into
e. I would love to but unfortunately, I'm struggling to understand it

4.8 | Facilitating conditions

Some participants considered QGIS to be compatible with all the geospatial technologies that they used (responses 23a, 23b, and 23c). Participant 5 thought that QGIS was compatible, but that they were not an expert in using QGIS (response 23b). According to Participant 11, all the QGIS plugins assisted with making it compatible and that this provided more analytical opportunities to the user (response 23c). Participants 1, 4, and 8 did not use any other geospatial technologies and were therefore not sure (responses 23d and 23e).

All participants agreed that QGIS was compatible with the data they used (responses 24a–e). Participant 5 felt that QGIS was compatible, because many of their clients worked with their data in QGIS (response 24b). Participant 11 said that if certain data would not open with proprietary software, QGIS would be used, and if data did not open in QGIS, they knew that something was wrong with the data (response 24e).

Most participants agreed that QGIS was compatible with the geospatial databases that they used (responses 25a–e). Participant 7 used QGIS outside the office, and the results were compatible with whatever tasks were performed at the office with proprietary software (response 25d). According to participant 9, even databases from ArcGIS could be opened in QGIS (response 25 e). Participants 4 and 8 never tried to use any databases in QGIS and therefore did not know whether it was compatible (response 25f).

TABLE 10 Questions and examples of responses related to facilitating conditions

23. Is QGIS compatible with other geospatial technologies you use?
a. Yes, it is compatible. Cause the kind of data that I use for ArcGIS and ERDAS can also be used on QGIS. So, it is compatible
b. Yes, I'm sure it is compatible with other geospatial technologies. Like I said, I[a] am not a fundi[a] on QGIS …
c. Yes, it is compatible with other spatial geospatial technologies … I use GPS data and it is compatible with that
d. I do not really use other geospatial technologies
e. I do not use any geospatial technologies or databases so difficult to say
24. Is QGIS compatible with all the data you use?
a. Yes, it is compatible for my data
b. Yes, it is compatible because a lot of people that are using our data use QGIS
c. I have to say yes to all of three … it seemed to be compatible with everything …
d. I think it is definitely compatible, I assume all the data can be opened in QGIS
e. … if something fails to load in Esri, I go and load it in QGIS, and if it does not load in QGIS I really know there's something wrong with that file
25. Is QGIS compatible with the geospatial databases you use?
a. Yes, with my PostgreSQL
b. I'm a big believer of storing my data in a database or not in some project format and it is compatible with both SQL and Oracle so I'm comfortable with that
c. Yes, it is compatible. Cause the kind of data that I use for ArcGIS and ERDAS can also be used on QGIS. So, it is compatible
d. … outside the office I use QGIS, within the office I use ArcGIS and the two systems, it seemed to be compatible with everything whatever I can do on the other side
e. … even the database from ArcGIS can be opened in QGIS. So, I think it is compatible
f. I do not use any geospatial technologies or databases so difficult to say

[a]South African English for an expert.

4.9 | Software support

Opinions about the quality of QGIS software support differed. Participants 1, 7, and 9 said that, whenever they needed support for QGIS, they used the Internet where good support was available (responses 26a–c). Participant 11 felt that "they should add a bit more writing novices to better understand the libraries used" (response 26e). Participant 5 did not know what support was like, because they did not use QGIS for production purposes, and similarly, participant 10 never looked for QGIS support because they did not use it (response 26d).

More than half of the participants did not feel that QGIS software support was expensive because it was free. This indicated that the participants might not have fully understood the question since support for QGIS can also be procured from private companies (responses 27c–e). Participants 5, 8, 9, 10, and 11 indicated that they did not know the answer to this question since they never needed support (responses 27a and b).

Most participants did not know who to contact when they needed software support for QGIS. They mostly agreed that they only knew about online video support offered by the Internet in terms of QGIS (responses 28c, 28d, and 28e). Only participants 5, 11, and 12 knew a person to contact for support (responses 28a and 28b).

TABLE 11 Questions and examples of responses related to software support

26. Is the software support for QGIS products good?
a. It is good support
b. … there's a lot of manuals available in order to use them
c. Yes, because so many people contribute …
d. I never looked for software support, QGIS support
e. … would think they should add a bit more writing novices to better understand the libraries and stuff they use
27. Is the software support for QGIS expensive?
a. Yeah, so I do not know, I cannot say
b. Is it expensive? I really cannot answer that I have no idea
c. It's not expensive
d. No, it's not expensive as it's a free open source
e. No, it's free
28. Do you know who to contact when you need software support for QGIS?
a. I know who to contact, yes
b. Yes, like I said, Kartoza or I think there's also online community probably with the developers and stuff on the QGIS website
c. … I do not know who to contact
d. I do not know who to contact when QGIS fails me, or I failed QGIS
e. I do not really know who to contact but I think I would, I would be able to find that online
29. Do you constantly need face-to-face software support for your GIS work projects?
a. Yes, I actually did ask one of my colleagues a couple of questions …
b. I do not need face to face support …
c. No. So you figure this stuff out yourself and you go the Internet and Google
d. Whenever I get stuck, I just go on Google and search whatever I am stuck on. I do not need face to face help …
e. I never had a need for face-to-face software support of QGIS
f. … in the office we use enterprise GIS
30. Is software support that the internet offers (blogs, on-line manuals, videos and tutorials etc.) in terms of QGIS more than enough for you?
a. It's enough
b. For most of the things that I wanted to do, I could find answers online
c. Yes, I think so there's more, more than enough to give you a good start
d. Yes, absolutely
e. I think when it comes to the videos and tutorials online manuals, I think even though it's not enough but there is something that can be very helpful for you

Only two participants needed face-to-face support for their GIS projects at work (response 29a). Others felt that one must just "figure it out on your own" and that they used the Internet for support (responses 29b–e). Participant 5 only used software support for the (proprietary) enterprise software (response 29f).

Participants agreed that software support offered on the Internet (blogs, online manuals, videos and tutorials, etc.) was sufficient for them (responses 30a–e). They reported that there was a magnitude of information on the Internet on how to use QGIS. Participant 4 felt that even though Internet support might not be perfect, there would be something that one could use to solve one's problem eventually (response 30e).

4.10 | Behavioral intention

Some participants who did not currently use QGIS, intended to start using it in future (responses 31a, 31b, and 31d). Others would continue using QGIS (response 31c). Participant 5 explained that as soon as they went on pension and did not have access to proprietary software anymore (as part of their daily job), they would start using QGIS (response 31d). Participant 9 felt that because of certain project commitments at work, QGIS would never be used (response 31e). According to Participant 10, QGIS would in fact be used in future, but only to teach people GIS skills, not for daily tasks (response 31f).

TABLE 12 Questions and examples of responses related to behavioral intention

31. Do you intend to start using QGIS in the future?
a. … definitely using it in the future
b. I'm definitely going to use QGIS again in future work
c. I'm going to keep on using it in future …
d. Yes, I intend to use QGIS in the future. So, when, when I go on pension, and that is close, I will not have access to licensed software then I'll be using I think then I will use it extensively
e. I am not seeing in the future that I will be using QGIS …
f. I prefer using QGIS in future, but not for me. Helping other people that does not have any GIS software …
32. Do you always try to use QGIS in your daily work?
a. I will stick with QGIS
b. Yes, I'm an ad hoc GIS user, which means I do not have access to license expensive software. So, whenever I need to do anything GIS my default would be to go to QGIS
c. No, at work we do not use the QGIS only use the ArcGIS
d. No. I prefer to use the recent ones like ERDAS and ArcGIS
e. I do not use it in my daily life because we use GeoMedia
f. … I do not integrate it into my daily map drawing routines
g. When I need to view something like I said earlier …
h. Not in my daily work at the moment, but they do use it in sales like I said, obviously for the dissemination they use the enterprise
33. Do you intend to continue to use QGIS in the future?
a. I will definitely continue to use it … seeing that it is free …
b. I'm definitely going to use QGIS again in future work
c. I'm going to keep on using it in future
d. As soon as I do not have access to the paid for software, I will be using QGIS. So, when I go on pension, I will be using that, of course, everything that is free, I'm going to use
e. I am not seeing in the future that I will be using QGIS
f. I prefer to use the recent ones like ERDAS and ArcGIS

Some participants would always try to use QGIS (responses 32a and 32b), while others indicated that they did not necessarily intend to use QGIS in their daily work. For example, QGIS was not currently part of the daily map drawing routines of participant 2, but he/she intended to use QGIS in the future (response 32f). Participant 3 preferred other proprietary GIS software for daily work purposes (responses 32d and 32e). Participant 4 was not using QGIS for daily work, since they were using proprietary software for that purpose (response 32c). Although participant 5 was not using QGIS in their daily work, some of their sales personnel were using it daily (response 32h). QGIS was the only software used by participant 12, since they did not have access to expensive licenses (response 32b). Participant 11 used QGIS daily when viewing data (response 32g).

Those who already used QGIS (participants 1, 4, 6, 8, 11, and 12), indicated that they intended to continue to use QGIS in the future (responses 33a–d). Participant 4 would continue because QGIS was free (response 33a). Participant 11 plans to use it more in the future (response 33d). Participants 9 and 10 said that they would not be using QGIS in the future (responses 33e and 33f).

5 | DISCUSSION

During the quantitative analysis, it was found that performance expectancy (PE) did not have a significant impact on a user's behavioral intention to use QGIS (Henrico et al., 2021). This was interesting since PE had a significant influence on the behavioral intention of users in other technology studies (Palau-Saumell et al., 2019). The interview responses presented in the previous section provide insight into why this variable was found to be insignificant. For some interviewees, expectation of performance was not a criterion when choosing a GIS product, because their employer prescribed a specific product, while others mentioned the open license of QGIS and plug-ins (and not necessarily performance) as a reason for it being useful.

The quantitative study indicated a strong correlation between the habit construct and PE (Henrico et al., 2021). Opinions about performance expectancy were divided in the interviews. Most participants felt that QGIS was not useful in their daily lives, did not help them to achieve their tasks more quickly, and that it did not increase their productivity and performance. However, this was because many of the participants did not use QGIS to perform their daily tasks at the workplace. Those who were familiar with QGIS and used it frequently were of a different opinion. These responses confirm that familiarity with a specific product (habit) influences performance expectancy.

In the quantitative part of our study, effort expectancy (EE) did not have a significant impact on users' behavioral intention to use QGIS, but EE had a moderate correlation to habit (Henrico et al., 2021). This was confirmed during the semi-structured interviews since most of the participants, regardless of whether they used QGIS regularly or not, agreed that it was easy to find training material for QGIS, that it was easy to become skillful in QGIS and overall, QGIS was easy to use. Freely available software and training material were stated as reasons for this. Those participants who did not use QGIS frequently, also found it less easy to use, explaining the moderate correlation between EE and habit.

Social influence had a significant impact on a user's behavioral intention to use QGIS in the quantitative analysis (Henrico et al., 2021). This is consistent with a UTAUT study that tested the acceptance of GIS, which also found that social influence had a significant influence on behavioral intention (Sun, 2011). In general, interviewed participants agreed that people whose opinions they value and who are important to them influenced which GIS product they used. In some cases, influential people considered recommending a switch to QGIS because it would bring a cost saving. The transition however never happened because they were not willing to learn how to use a new product and waste their time trying to do so, or because they did not want to make the effort of converting the organization's information systems to another product.

In the quantitative part of the study, hedonic motivation was found to be insignificant in relation to a user's behavioral intention (Henrico et al., 2021). The interview responses provided insights into why this construct did not impact the behavioral intention of users. Although some participants felt that QGIS was a user-friendly product, it was not fun and entertaining because it was used for work and/or too complicated to use. On the other end of the spectrum, one participant said that “any GIS software is fun to use” and entertaining. Hedonic motivation is often

found significant when acceptance of gaming technologies is tested (Wang et al., 2020), that is, this construct is probably less relevant for software acceptance in the workplace.

Most of the participants used QGIS because it was free. This was consistent with a survey done by Ashnik.com (2022) which cited that for 84% of the participants in Southeast Asia and India, cost efficiency was a deciding factor when choosing open-source technologies. This confirmed the results of the quantitative analysis (Henrico et al., 2021), which indicated that price value had a significant impact on a user's behavioral intention to use QGIS. We had expected this since South Africa is a developing country where resources tend to be limited. Participants regarded QGIS to be of good value considering that it was free and despite the fact that it was free, that is, QGIS is considered to be of good value per se, not just because it is free. Even though participants felt this way about price value, some participants reported that habit and the workplace environment were more significant for work purposes: they used the GIS product that they were familiar with, even if it came at a greater cost (to their employer), or they used the GIS product prescribed by the workplace environment.

Habit was found to have the greatest significant influence on users' behavioral intention to use QGIS in the quantitative part of the study (Henrico et al., 2021). The semi-structured interviews confirm this and also revealed that habit is not necessarily related to the entire product, but may be related to a certain kind of functionality that the product offers. For the entire product, opinions were split about whether using QGIS was a habit or not. However, for most participants, it had become a habit to use QGIS for viewing data, for some digitizing in QGIS had become a habit but for most conducting analytical tasks in QGIS was not considered to be a habit, since they used another GIS product for those tasks.

We added the source code construct to the original UTAUT2 model since it plays such a significant role in the development cycle of open-source software. However, during the quantitative analysis, source code did not have a significant effect on the behavioral intention of geospatial practitioners to use QGIS (Henrico et al., 2021). The interviews provided insight: participants were not using QGIS for its source code and did not know how to inspect or modify the source code. The interviewees and questionnaire respondents were selected to be GIS users, not necessarily developers, which can explain this result. In future, one could repeat the quantitative and qualitative study with GIS software developers, which may result in different findings.

Facilitating conditions were found to have the second most significant role related to behavioral intention during the quantitative analysis (Henrico et al., 2021). Generally, interviewees reported that QGIS was compatible with the geospatial technologies, data and geospatial databases that they used, and this encouraged them to use QGIS. This allowed some interviewees who do not use QGIS at the workplace, to continue with a project at home where they do not have access to the proprietary software.

Software support was not included in the UTAUT2 model analysis (quantitative analysis) because it was found to be irrelevant (Henrico et al., 2021). The interviews provided insight: participants agreed that QGIS support on the Internet was good (or at least adequate) and inexpensive (free). Some felt that one does not need face-to-face GIS support (for any product). Most participants did not even know a person or company to contact for QGIS support. Some did not use QGIS daily, and therefore never looked for software support and did not have an opinion.

Finally, the interview responses confirmed that users had a specific behavioral intention about using QGIS in future—to continue to use it, to start using it, or not likely to ever use it. In an article about predictions made for open-source technologies in 2022, the author also states that the use of open-source software is expected to grow steadily (Opensource.com, 2022). Anadiotis (2022) also states that "open source software has been on the rise for a while, and we don't see any signs of this growth slowing down."

6 | CONCLUSIONS

Previously, we reported on a quantitative analysis we conducted on the reasons South Africans use QGIS (Henrico et al., 2021, 2022). Here, we report on a qualitative analysis, based on semi-structured interviews. This provided valuable insight into understanding the results of the quantitative analysis. The qualitative results confirmed those of the earlier

articles and provided a deeper understanding of them. Specifically, habit is the main reason people use a specific GIS (e.g., interviewees have a clear preference for a specific product for certain kinds of tasks). The GIS product prescribed by their workplace also plays an important role. Other reasons are facilitating conditions (e.g., interviewees use QGIS because it can open most data formats), price value (e.g., interviewees use QGIS because it is free) and social influence (e.g., interviewees had been advised to switch to QGIS). Software support was not significant in the quantitative study and the interviews revealed why this was the case—because GIS software support is often not necessary, or else readily available online. This study confirmed the finding of the earlier article, that users consider cost benefits and the availability of support when deciding to use QGIS, but not some of the benefits generally attributed to open-source software, such as customizability, no vendor lock-in, improved reliability, quality, and security. This can be explained by the fact that the users in our study are not involved in GIS procurement decisions where security or vendor lock-in may play a role.

The results of our analyses can help the promotors of open-source software increase the uptake of their products, for example, by not only promoting their products to users but also to those involved in procurement decisions. In general, they can also help managers in any organization embed new products into their workflows, for example, by noting the importance of social influence when introducing something new to users. Managers play an important role in deciding which GIS product is used and encouraging users to experiment with a new product. Our study focused on users who are not involved in GIS procurement decisions, and therefore managers involved in such decisions could be the focus of future research. To verify whether our results about users are generally applicable, the study would have to be repeated in other communities in South Africa and in other parts of the world.

ACKNOWLEDGMENT

We would like to thank the South African National Defense Force (SANDF) for funding Susan Henrico's PhD studies (Henrico, 2020).

CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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REFERENCES

Abdellah, Z., Aminearrahmane, A., & Fatima, J. (2016). Factors affecting adoption of FLOSS ERP system by SMEs f directors and managers in developing countries using UTAUT2, SEM and R. 4th IEEE International Colloquium on Information Science and Technology, Tangier-Assilah, Morocco (pp. 25–30). IEEE.

Alalwan, A. A., Dwivedi, Y. K., & Rana, N. P. (2017). Factors influencing adoption of mobile banking by Jordanian bank customers: Extending UTAUT2 with trust. International Journal of Information Management, 37, 99–110. https://doi.org/10.1016/j.ijinfomgt.2017.01.002

Ameen, N., & Willis, R. (2018). An analysis of the moderating effect of age on smartphone adoption and use in The United Arab Emirates. UK Academy for Informtion Systems Conference (p. 1). Oxford, UK. https://aisel.aisnet.org/ukais2018/1

Anadiotis, G. (2022). 2022 technology trend review, part one: Open source, cloud, blockchain. https://www.zdnet.com/article/2022-technology-trend-review-part-one-open-source-cloud-blockchain/

Arenas Gaitán, J., Peral Peral, B., & Ramón Jerónimo, M. (2015). Elderly and internet banking: An application of UTAUT2. Journal of Internet Banking and Commerce, 20(1), 1–23. http://hdl.handle.net/11441/57220

Ashnik.com. (2022). The state of open source survey 2022: Southeast Asia and India. ASHNIK Pte Ltd. https://www.ashnik.com/the-state-of-open-source-trends-2022/

Avand, M., & Moradi, H. (2021). Using machine learning models, remote sensing, and GIS to investigate the effects of changing climates and land uses on flood probability. Journal of Hydrology, 595, 125663. https://doi.org/10.1016/j.jhydrol.2020.125663

Bridge, R. (2017). Open source software: Advantages & disadvantages. Entrepreneur Handbook. https://entrepreneurhandbook.co.uk/open-source-software/

Bromhead, B. (2017). 10 advantages of open source for the enterprise. Opensource.com. https://opensource.com/article/17/8/enterprise-open-source-advantages

Chang, C.-M., Liu, L.-W., Huang, H.-C., & Hsieh, H.-H. (2019). Factors influencing online hotel booking: Extending UTAUT2 with age, gender, and experience as moderators. Information, 10, 281. https://doi.org/10.3390/info10090281

Coetzee, S., Smit, J., & Rautenbach, V. (2018). Perceived supply and demand for GISc knowledge and skills in South Africa. AfricaGEO 2018 Conference. Gauteng, South Africa.

Fletcher-Lartey, S. M., & Caprarelli, G. (2016). Application of GIS technology in public health: Successes and challenges. Parasitology, 143, 401–415. https://doi.org/10.1017/S0031182015001869

Hall, G. B., & Leahy, M. G. (2008). Open source approaches in spatial data handling. Springer.

Henrico, S., Coetzee, S., & Cooper, A. (2020). Is open source GIS feasible in military operations? Evaluation by applying a USE case. Scientia Militaria: South African Journal of Military Studies, 48, 41–60. https://doi.org/10.5787/48-1-1259

Henrico, S., Coetzee, S., & Cooper, A. (2022). The role of age, gender, experience, education and professional registration in acceptance of QGIS in South Africa. Transactions in GIS, 26, 459–474. https://doi.org/10.1111/tgis.12857

Henrico, S., Coetzee, S., Cooper, A., & Rautenbach, V. (2021). Acceptance of open source geospatial software: Assessing QGIS in South Africa with the UTAUT2 model. Transactions in GIS, 25, 468–490. https://doi.org/10.1111/tgis.12697

Henrico, S.J. (2020). Understanding the acceptance and use of open source geospatial software – The case of QGIS in South Africa [PhD Thesis]. University of Pretoria.

Landres, P. B. (2001). GIS applications to wilderness management: Potential uses and limitations. US Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Miladinovic, J. (2016). A study on factors affecting the behavioral intention to use mobile shopping fashion apps in Sweden [B.A. Thesis]. Jönköping University.

Morosan, C., & Defranco, A. (2016). It's about time: Revisiting UTAUT2 to examine consumers' intentions to use NFC mobile payments in hotels. International Journal of Hospitality Management, 53, 17–29. https://doi.org/10.1016/j.ijhm.2015.11.003

Noyes, K. (2010). Reasons open source is good for business. PCWorld. https://www.pcworld.com/article/498425/10_reasons_open_source_is_good_for_business.html

Opensource.com. (2022). 6 predictions for open source tech in 2022. Opensource.com. https://opensource.com/article/22/1/open-source-predictions-2022

Otter.ai. (2020). https://otter.ai/about

Palau-Saumell, R., Forgas-Coll, S., Sánchez-García, J., & Robres, E. (2019). User acceptance of mobile apps for restaurants: An expanded and extended UTAUT-2. Sustainability, 11, 1210. https://doi.org/10.3390/su11041210

Sun, Y. (2011). Factors influencing the diffusion of the GIS technology by SBD Qingdao: An [sic] UTAUT approach (Master in Business Information Systems Management). New Zealand: Massey University.

Sutton, T. (2018). Deciding between FOSSGIS and proprietary software in the enterprise. GIM International. https://www.gim-international.com/content/article/deciding-between-fossgis-and-proprietary-software-in-the-enterprise

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27, 425–478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarterly, 36, 157–178. https://doi.org/10.2307/41410412

Venkatesh, V., Thong, J. Y., & Xu, X. (2016). Unified theory of acceptance and use of technology: A synthesis and the road ahead. Journal of the Association for Information Systems, 17, 328–376. https://doi.org/10.17705/1jais.00428

Wang, Y.-Y., Wang, Y.-S., & Jian, S.-E. (2020). Investigating the determinants of students' intention to use business simulation games. Journal of Educational Computing Research, 58, 433–458. https://doi.org/10.1177/0735633119865047

Wheeler, D. (2015). Why open source software/free software (OSS/Fs, Floss, or FOSS)? https://dwheeler.com/oss_fs_why.html

How to cite this article: Henrico, S., Coetzee, S., & Cooper, A. (2022). Qualitative insights into the acceptance of QGIS in South Africa. Transactions in GIS, *26*, 3295–3314. https://doi.org/10.1111/tgis.13003