Assessment of the Public Value of Open Data in Ghana

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Abstract. With rising enthusiasm for Open Data (OD) globally, there has been an expanding requirement for research on the impact this movement has created. Ghana is considered as one of the early Open Data adopters in Africa. The case of Ghana presents an interesting and a unique area of concentration due to the country's long stand in democracy. The practice of democracy, accountability and transparency has been the core of government development in Ghana since independence in 1957. The research purpose is to understand and examine the impact of Open Data from the context of Ghana from the perspective of created public value. Existing studies in Open Data has focused on the supply-side. These studies have discussed issues relating to licensing, policies, power relationship between government stakeholders and the technological platforms of the phenomenon. Less is however, known of the impact Open Data on citizens and government of developing countries after about four years of embracing the initiative. The research question underlying this study is: What public value has Open Data created in Ghana? To answer this research question, the study adopts a post-positivist methodology and deductively adopts the public value framework as the theoretical lens. With reference to the public value framework the study posits that the major impact of open data in Ghana is related to intrinsic enhancements, stewardship, quality of life, economic empowerment.

Keywords: Open Data (OD), Open Government Data (OGD), Public Value, Ghana

1 Introduction

Open Data involves unrestricted access, use and reuse of data at the least cost possible. Open Data therefore incorporates the technical and legal availability of data. Making data available to enhance decision making, open/public participation and reusable is the main aim of Open Data [1] [2]. Open Data unlocks a new wave in the digital age that is focused using technology to improve on the lives of people. This is achieved through the increase democracy/ transparency and citizen participation [3]. Citizen participation is mostly unearthed through the activities of intermediaries. These intermediaries through innovation, invent various products/services by leveraging on Open Data. These products include mobile apps and polices that creates public value and bridge the literacy gap. In Ghana for instance various mobile based applications has been developed that leveraged on Open Data for smallholder farmers. Open Data involves diverse stakeholders/actors [4] [5]. These actors/stakeholders constitute the demand and supply

sides of open data. The demand sides are the data providers, who make data available in different formats to enable use and reuse by the public including intermediaries [1].

Openness is expected to yield public value/ benefits such as, increase in economic growth and innovation through the use of available data [6] the challenge however is the inability to predict the return on investment. Based on interviews and workshops [6] noted that the benefits of Open Data can be grouped into political, operational, social, technological and economic [6]. For example, the political benefits of Open Data include increase in participatory governance (via citizen/government decision making), trust, transparency, policy making and data access equality. In addition, data reuse (no duplication), easy access to data, improved policies and sustainable data are among technical and operational benefits. The authors however, noted the evidence of a struggle in separating some of the benefits by the interviewees, an example relates to the social and political benefits of Open Data from the perspective of the respondents.

Research in Open Data in developing countries has thus far focused on: value of Open Data licensing [7] in Cape Town and Kenya, fostering citizens adoption in Ghana [8] and power play between different stakeholders in Kenya [9]. There has been a little focus on the impact from the perspective of public value creation after years of participation in the initiative. The focus of these studies has also been limited to the supply side and less on the demand side. This study therefore addresses both the supply and demand sides of Open Data in Ghana.

The aim of this study is to understand and unearth the public value created by open data in a developing country. This will be achieved through the use of post-positivist research paradigm as the philosophical and methodological lens and the public value framework as the theoretical lens. Inferring from this background, the study seeks to uncover the substantive and ideological impact of Open Data in developing countries. Contextualized research in Open Data has been recommend due to the infancy nature of the phenomenon [10].

This paper is structured as follows: section 2 presents the literature review on OD. This is followed by a discussion of the theoretical foundation in section 3. Section 4 presents the methodology. Section 5 presents the findings of the research, followed by the discussion based on the theoretical framework. The final section presents the conclusion, recommendations and areas for future studies.

2 Aims of OD

The major aims of Open Data are: fostering democracy, increase in citizen participation, promoting accountability, trust and transparency [8][6]. Trust is regarded as an output of openness. [8] for instance, noted the problematic nature of trust in government citizens and thus posited that Open Data is one of the ways by which the trust relationship citizens and government can be improved. Citizens desire to be involved and participate in government activities and decision making through democracy [3] can be achieved via Open Data. Through the practice of democracy, government is expected to become more transparent and accountable for their activities and decisions [11,12], 13] and Open Data makes this possible. Thus openness is a movement from ‘closed to

open' systems [14]. Theoretically, Open Data research in developing countries has thus far used the Actor Network Theory [9] and Open Data in Developing Countries Conceptual Framework [15]. Others have focused on document analysis [8]. The theory and conceptual model have focused less on the impact/ public value. The public value of any government initiative is attained after performance measurement is undertaken and its relevance in Open Data is inevitable. Public value refers to the creation of equitable benefits by the government to citizens and other stakeholders [18].

The mere release of Open Data does not guarantee impact; in fact, nothing is further from the truth, popular expectations or best intentions notwithstanding. "Build it and they will come" is wishful thinking, perhaps based on aspirational benefits over-sold by well-meaning open data advocates. The more mature the data ecosystem and more advanced the state of the knowledge economy, the more benefits typically accrue.

One of the easy traps to fall into is to focus on the low-hanging fruit, that is, release as many 'ready' datasets as possible, forgetting that it is not the size of the data or the number of datasets that will determine the success or impact of an Open Data initiatives. Rather, the data needs to address specific needs or important data gaps. In fact, releasing too many datasets may have the opposite effect: a few good datasets can get lost ('buried') under a huge number of largely irrelevant or virtually useless other datasets. The necessity to liaise with potential or actual Open Data users is one of the key recommendations of the GODI report and arose in most of the impact case studies.

There are many other factors that play a crucial role in determining the impact of Open Data. The role of intermediaries is crucial: releasing the right open data into a mature and sustainable data ecosystem will ensure and enhance its impact when compared to immature ecosystems [2]. [16] Suggests the following six crucial characteristics before open data can make a developmental impact: scrutiny, participation, equality, flexibility, trust and value amplifier.

Measuring the impact of OGD has proven to be notoriously difficult, given the vast nature of the social, economic, political, and environmental implications of the intended and actual use of OGD. The complexity involved in such measurement has been acknowledged, as well as demonstrated, by the rarity of established frameworks to measure the phenomenon [16] or studies that clearly assess impact of OGD in great detail [17]. In light of this "counterproductive" scenario in the OGD research space (given the investments made towards OGD initiatives), the Open Data Barometer has emphasised the need for more structured research and analysis on the impact of OGD in order to demonstrate the value of the initiatives [17].

Consequently, this study adopts the Public Value framework as posited by [18]. The authors suggested that, the impact of open data can be accessed based on the public value it creates for citizens. The Public Value Frameworks argues for a multi-stakeholder perspective when formulating frameworks to measure Open Data impact/public value. Before the impact/public value of Open Data can be measured it is necessary to recognize the expected type of public value to be created and the level from a multi-stakeholder perspective.

3 Theoretical Foundation

This study is deductively motivated by the public value framework presented by [18] as the analytical lens to understand the impact of the research phenomenon. Public value, is equitable benefits created by government to citizens based on "properly ordered and productive public institutions" [19]. Although [18] applied the public value framework to open government and e-government in general, this study adopted and used the framework as a lens to assess the impact/public value of open data in Ghana. The authors noted that the essence of any e-government project is to promote public value for both citizens and governments. Thus, public value can be realized when government-based institutions engage in activities that are beneficial to the society and citizens. Public value from the perspective of citizens is tied to openness, accountability, sustainability, transparency, service quality, accessibility and citizen awareness [18], these tenets are considered as relevant parts of Open Data initiative. An empirical understanding of public value from the perspective of multiple stakeholders facilitates the understanding and formulation of required strategies and laws to harness adoption and usage. [3], however asserted that, the different roles of multiple stakeholders in the Open Data initiative may influence the public value generated. Public administrators for instance although are data providers, then can also be participate in with other stakeholders through discussion [3]. The discussion or collaboration roles of OD actors or stakeholders births varying views. [3], further posited that stakeholders can have either a 'critical/monitory' or a 'participatory' view of OD.

The relevance of Public Value Framework in Open Data research is reflected in the claim that, merely publishing datasets does not necessarily result successful adoption and use; citizens should be able to attach and create value to the data [1, 2,18], which is mostly created by intermediaries. This provides bases to find empirical explanations to what citizens consider as public value pertaining to Open Data from the perspective of a developing country. Openness is one of the ways by which citizens can interact, participate and assess decisions taken by governments [20]. While [19], discussed the relevance of public value in government initiatives, a systematic method on how to analyze and access public value with regards to government initiatives was not presented. [18], therefore, provided systematic multi-stakeholder method for analyzing public value from the perspective of Open Government. This study consequently, adopted the systemic method as posited by [18] to unearth the public value of Open Data in from the perspective of a developing country. [18], further noted that the impact of OG can be either ideological or substantive. Ideological impact relates to intangible public value such as beliefs while substantive impact is based on tangible created public value. The creation of Substantive Public Value through the use of Open Data is Table 1 provides a detailed explanation of the impact of Open Government.

Table 1: Public Value Framework [18]

Substantive	Impact	Explanation and Contextualization
	Economic	"Future and current income, liabilities, entitlements, values of asserts and aspects of wealth and risk "generated as a result of the use of Open Data.

	Political	Using Open Data to influence of stakeholders, groups on government activities, role in political issues and public offices
	Social	Effects on relationship- family, communal, status identity and movement due to the use of Open Data.
	Strategic	The use of Open Data to influence benefits and innovative resources at the individual or group level
	Quality of life	The use of Open Data to influence overall well-being, example, health, security, ad satisfaction (group/individual).
Ideological	Stewardship/ power	Interpretation of performance of government (trust, integrity, equity) at the public level through the use of Open Data.
	Intrinsic/ extrinsic enhancements	Influence on beliefs systems, morality, and ethics in relation to government activities or strategies due the use of Open Data.

Public value can be created grounded in six (6) iterative steps including: a process of describing the initiative based on the purpose and goals; identifying and prioritizing stakeholders involved-which in the context of this study are the supply and demand sides of Open Data; identifying the created public value as explained in Table 1; identifying from the stakeholders perspective feasible mechanisms of change; synopsize public value and conduct a review of Open Government (in this study Open Data) portfolio [18]. The use of the public value framework in this study was necessary to help uncover Open Data impact from the perspective of from a multi-stakeholder perspective within the Open Data ecosystem in Ghana.

4 Methodology

The study adopted a post-positivist paradigm and methodology to guide data collection and analysis. The paradigm acknowledges the subjective interdependent relationship between environmental/social structures, attitudes and behavior of individuals [21]. Post-positivists then proceeds with an objective enquiry as suggested by positivism, which is only a part of reality [22]. Post-positivists aim at developing in-depth insight into the dynamics of a social phenomenon [23]. Thus post-positivists attempt to establish and search for 'warranted assertbility' [24] which is valid and sound proof evidence for an existing phenomenon [25]. The difference between post-positivists and positivist is grounded on the former's view on knowing implicit truth via generalization. Although, 'truth' and 'evidence' lies within the domain of positivist research [26], post-positivists advocates for researchers to be deliberately critical by testing thoughts with evidence based confirmation to prevent despotic research [27].

Methodologically, post-positivists supports pluralism where the research question informs the method to be applied [26]. Thus post-positivist can adopt either or both qualitative and quantitative methods [28] also referred to as 'critical miltiplism'. The critical aspect of post-positivism calls for rigor, precision, logical reasoning and focus

on evidence while multiplism accepts the use of varying point of views understand research questions, methods, analysis and interpretation of results. The post-positivist paradigm and methodology seeks knowledge into social phenomenon by using a qualitative perspective to gain understanding of the phenomenon and quantitative method for the purpose of validation. Post-positivist research methods allows researchers to be both 'interpretive and empirical'; 'multivariate and experimental'; 'interventionist and observational' [29]. To this effect, this study aligned itself with the qualitative post-positivist stance and seeks for verification of results through the use of multiple data collection methods and objective data analysis for the purpose of triangulation.

Consequently, data for this study was collected from multiple sources including semi-structured face to face interviews, documents, websites and observations. Although documents and websites were used as sources of data, they provided the authors with additional information the background of the organizations. The face to face interviews on the other hand provided the authors with in-depth information on the public value created. Data gathering started from March to August 2018. We conducted a number of semi-structured and structured interviews with key informants who were the actors/stakeholders within the Open Data ecosystem in Ghana. They were categorized into NGOs, associations, journalists, bloggers, public administrators, academicians and citizens. Prior to the semi-structured interviews, we conducted a thorough online search for the use and of Open Data in Ghana. This enabled us to know the exact users of Open Data and out of that we were able to ascertain its potential impact. Consequently, respondents were selected based on purposive sampling and snowballing [30]. Data was gathered from both the supply and demand sides of Open Data in Ghana and a cross-section of the citizens, who constituted the beneficiaries of Open data in Ghana. The table below provides a summary of the interviews.

Table 2:Summary of Interviews

	Unit of Analysis	**Unit of Observation**	**Sources of Data**	**Details of Documents**
Supply Sides	SS1	2	Group interviews, observation, website and Documents	National Action Plans, Survey reports, yearbook, reports on background of SS 1, 2
	SS2	2	Individual interview, observation, website and documents	
Demand Sides	DS1	2	Group interviews, websites and participant observation	
	DS2	3	Group interviews, websites and observation	

	DS3	3	Group interviews, websites and observation
	DS4	3	Group interviews, websites and observation
	DS5	3	Group interviews, websites and observation
	Beneficiaries	10	

The interview sessions were designed based on guides that encompassed emerging insight from Open Data. Each interview based between 30 minutes to 1 hour and was either audio recorded or written as part of field notes, depending on what the respondents were most comfortable with. Respondents were given the ethics approval report prior to the interview. Subsequently, data was transcribed for detailed analysis.

5 Data Analysis

Data analysis ensued iteratively with data gathering, to unearth public value thus far created by both the supply and demand sides of Open Data in Ghana. The analysis was deductively informed by the public value framework posited by [18]. Based on the perspective of post-positivist analysis, we used the framework as a sensitizing lens [27] to enable the researchers understand the data in both a qualitative and objective manner. Accordingly, analysis was informed by the philosophical underpinnings of the study; thus, although the study adopted a qualitative methodology for data gathering, the analysis was presented and discussed from an objective perspective with an aim of arriving at 'one truth' and validating through triangulation. The goal was to achieve the tenets of validity and triangulation in post-positivist research.

5.1 Case Description: Ghana Open Data

Ghana is located on the western belt of Africa with an estimated population of 28million. The country currently has an elected president, with parliamentarians of about 272 in number. Based on the democratic background of the country it has an independent judiciary and electoral commission. Open Data in Ghana can be traced to late 2011, when the then president, His Excellency Professor. J.E. Mills signed the Open Government Partnership (OGP) which was the initial inclusion of Ghana into the global open government initiative.

5.2 Supply-side

The Ghana Statistical Services (GSS) and National Information Technology Agency (NITA) constitutes the primary government-based supply sides of Open Data in Ghana. Ghana Statistical Service (GSS) in 1948 became the main government statistician. The institution was authorized by government to institutionalize the collection and dissemination of statistical data. The aim of this was to provide evidence-based decision making, national development and good governance through the collection and distribution of quality data. With is mandate GSS collects, compiles, processes, stores and disseminates official statistical data on Ghana. This mandate requires a collaboration with the various Ministries, Departments and Agencies (MDAs) and other data generated institutions in Ghana. In 1985 the activities of GSS was legally institutionalized by the PNDC Law 135.

5.3 Demand-side

The demand-side of Open Data in Ghana constitutes third party international organizations such as the UNDP and the UNFAO. These international organizations also act in the capacity of third party supply-side of Open Data in Ghana. Other demand-sides of Open Data in Ghana are categorized in the table below. The demand-sides explained in the table below have developed various platforms and technological products by leveraging on both available and real-time generated data in Ghana.

Table 3: Demand-side of GODI

Demand-side	Sector	Initiative	Focus
Farmerline	Private	Mobile SMS solutions	Smallholder farmers
Esoko	Private	Mobile SMS solutions and Inyst	Farmers and government
Vodafone farmers club	Private	Mobile solution	Farmers
TRACTOR	Private	ICT based localized farming solutions	Farmers
Data Journalism	Private	Report	Women, cocoa farmers, etc.
GINKS	Private	Training on evidence-based policy making	Parliament Staff
Odekro	Private	Reports on parliament proceedings, organizes polls on parliament activities via social media	Parliament and citizens
Mobileweb Ghana	Private	Open cities Accra	Citizens
Data science Africa	Private	Animation mobile application to address flooding	Citizens

Tigo Fishers Network Initiative	Private	Mobile solutions	Fisher folk
Code 4 Ghana	Private	Data-driven apps	Citizen empowerment
iWatch Africa	Private	Promoting Transparency	Citizen participation
Penplusbytes	Private	Training of Data Journalist	Citizen participation
Accra metropolitan Assembly	Public	Mobile app to enhance sanitation (ESICAPP)	Citizens

Table 2 shows how open data is being leveraged upon in Ghana by the different demand sides. Some of the demand-sides leverage on either aggregated or disaggregated data to produce mobile-technology driven solutions for citizens. Others also leverage on Open Data to encourage citizen participation and formulate policies. As noted by respondents:

"Open data is not only about the format but making data available to those who need it in any format possible at low cost. That is how the impact of Open Data can be attained and increased in the country. There is therefore a need for different models and technologies that can make data accessible, usable and beneficial to citizens."

Farmerline

Famerline is a Ghanaian Technology provider which uses SMS to provide data-driven solutions aimed at empowering small-scale farmers in Ghana. This is achieved through the use of mobile generated data from both primary and secondary sources. Farmerline is grounded on the perspective of a social enterprise that seeks to provide smallholder farmers with simple mobile technology solutions and real-time data through aggregation and disaggregation of Open Data on agriculture. The company helps farmers prevent post-harvest losses and regular low yields due to lack of knowledge on market prices and techniques to interpret data via mobile communication infrastructure. The company initiated the Apps4Ag that provides training on data collection apps for agriculture and rural projects and tools for improved information access for smallholder farmers. The impact of farmerline's activities is its ability to contribute to bridging the illiteracy gap and poor internet connectivity through open Data. This is evident in the type of services they provide which includes outbound messaging to provide personalized voice alerts that communicates critical information on aggregated market prices, farming techniques and weather forecast; as well as mobile surveys that capture the impact of interventions of farmer-driven associations.

Esoko

Esoko is another mobile service organization aimed at responding to farmers needs in Ghana through mobile technology. Esoko provides customized services such as SMS based market price, weather alerts, crop advice and bridging the gap between sellers and buyers in local languages. This is achieved by leveraging on smart phones and tablet devices to collect agriculture data in real-time. The organization developed the Insyt, a real-time data collection tool which became the pillar for some government intervention programs, for example, the Livelihood Impact Empowerment Against Poverty (LEAP). With the aid of the Insyt Esoko was able to profile 150,000 poor

households in 50 districts across the ten regions in Ghana in real-time. Using a customized survey tool and by creating an easy, instant and comprehensive profiling protocol, Esoko was able to reduce UNICEF's profiling error rate from 55% to 0%. Esoko is now extending its presence into other African countries.

Vodafone Farmers Club

Vodafone Ghana has leveraged Open Data to bridge the gap between farmers and extension officers by creating the Vodafone Farmers Club. This innovation is important as respondents of this report noted the scrapping of the role of extension officers and the need to reach rural farmers through data driven-tech innovations. The Vodafone Farmers Club is targeted at providing a real-time solution to farmers at a low cost of GH¢2 a month.

Odekro

Odekro is a civil society group with an aim of empowering citizens through open, real-time data from parliament and other sources. Odekro provides live telecasts of the parliament proceedings. By leveraging open data, Odekro, has created reports on parliamentarian's absenteeism, corruption and how parliamentarians in Ghana use social media. For instance, in June 2018, Odekro released a report on the cost incurred as a result of parliamentarian absenteeism. The report revealed that this behavior cost the country about ¢1.4 million (US$300,000). Fifty-four Members of Parliament (MPs) during the data collection period violated the constitution by absenting themselves from parliament without permission: *Overall 54 MPs reached and crossed the 15 sittings absence threshold without permission, thus violating Article 97 (1) (c) of the 1992 constitution of Ghana, since there is no there is no material evidence that they sought permission in writing form the speaker".* Its crowdsourcing aspect is where it conducts Facebook polls, such as prior to Public Budget releases, to raise awareness about the upcoming budgets but also to inform policy makers about the citizen expectations.

Ghana International Network for Knowledge Sharing (GINKS)

The Ghana International Network for Knowledge Sharing (GINKS), aims at alleviating poverty with the aid of ICTs, information and knowledge sharing among all stakeholders (Ahiabenu, 2007). Data is collected through monitoring and evaluation as well as crowdsourcing to enable knowledge sharing among networked members. GINKS also target at making ICT accessible to all Ghanaians while also addressing the challenges within the ICT environment in Ghana. GINKS has organized various training programs for civil servants including parliamentarians in Ghana. For example, in 2015 an Evidence-Informed Policy Making (EIPM) training course was organized for civil servants in Ghana to enable them deal with policy formulation and public interest challenges. A follow up showed that, the skills of participants had improved in areas of assessing evidence/information sources, contribution to policy documents and communication. One of the participants was able to develop an information request form for front desk personals, to enable them regulate and clarify information requests [32]. Another workshop was organized by GINKS, African Centre for Parliamentary Affairs (ACEPA) with support from International Network for the Availability of Scientific Publications

(INASP) for information support staff of parliament. This training was aimed at *"helping parliamentary staff understand the factors affecting evidence in the various departments of parliament and approaches to handling these issues"*.

Data Journalism

Although data journalism is considered to still be at the infancy stage in Ghana, the concept and practice is gradually gaining grounds, especially after Ghana's inclusion in the Open Data initiative. In 2012, GODI introduced a data and digital skills training session targeted at data journalists under the theme of "Elections and Civic Watchdogs Media using Open data". Later in October 2012, the National Information Technology Agency (NITA), organized a three-day Data Journalism Boot Camp for journalists in Ghana, also to train them on how to use Open Data. Another two-day training was organized by Canadian volunteers and journalists for Human Right trainers equipping about ten journalists from the various Ghanaian media outlets to help them disseminate stories that are based on accurate OD.

The African Media Initiative, Mobile Web Ghana and the World Wide Web Foundation implemented the Code for Ghana in 2015. Code for Ghana was aimed at forming a community of civic inclined technology and open data professionals. These professionals were attached to media houses in Ghana to drive data journalism. Code for Ghana also wants to create a movement helping citizens use open data.

In 2014, another training forum on open data in journalism was organized by International Institute of ICT Journalism with support from STARGhana in the Volta Region. The theme for the forum was "Open Ghana-Data Journalism for Improved Maternal Healthcare Delivery" to create a collaborative engagement platform for journalists, health officials and other key stakeholders, to help mitigate maternal mortality. A case study was targeted at four densely populated areas in the Volta Region; namely Ho, Hohoe, Kpando and South Dayi.

"*Based on OD from Ghana health service it was noted that infants were continuously dying in particular communities. So, a workshop was organized, and data was pushed and made available to understand what was really going on - cause of the increase in child mortality. The simple cause was that when a mother gives birth, the mother does not have time to breast feed the child, they think breast milk is just water, just normal water [...]. We educated them on the nutritional value of breast milk and different types of food, data journalists participated in the education through reporting in local languages. Within one year, there was success [...] as women become more conscious of breastfeeding, we could see that the issue of malnutrition in those communities was disappearing."*

In February 2015, the National Resource and Governance Institute and the International Institute of ICT Journalism (Penplusbytes), introduced Data Dive. Data Dive was a three-day course aimed building the capacity of their alumni in story production in the extractive sector. The theme was: 'Drilling Down: Ghana extractives data dive". The project was also supported by Omidyar Network, which forms part of the Institute's CODEX (Catalyzing Open Data for Extractives) project. The project was designed to proliferate the use of extractive industry data to increase relationships between extractive revenues and outcomes targeted at human development.

The impact of OD on data journalism is noteworthy. Two Ghanaian investigative data journalists in 2017 received grants from impactAfrica for their projects. Likewise, a data journalist from an Accra based radio station won a US fellowship for data journalism project.

6 Discussion: Assessing the Impact

Findings from this report indicates that Ghana appears to be fully committed to open data, although the RTI law is not yet fully functional. There is need for public value to be created for the citizens whose data forms the core of the OD movement. However, findings from this revealed that the public value created in Ghana thus far, is limited to specific sectors, such as agriculture. Thus, if "public value" is created by private organizations in an economic way, there thus a need for public sectors to also create "public value for citizens"[33][19]. The impact of open data thus far achieved in Ghana inferring from the proposed framework include intrinsic enhancements, social, economic, quality of life, stewardship, strategic and economic. It is, however, important to note that there is evidence of overlapping in the public value framework. As some of the activities of both supply and demand sides can be found in more than one category. The sub-sections below explain the impact in detail.

6.1 Intrinsic enhancement and Power

[18], define intrinsic enhancement as an impact that is reflected in "influence in belief system, morality and ethics in relation to government activities or strategies". This impact has been partially attained through the work of Odekro and GINKS. Odekro, by capitalizing on Open Data has provided a platform that enables citizens participate in various government activities. For example, citizens become aware of the activities of their parliamentarians based on their punctuality and engagement in parliamentary proceedings. This influences their belief systems in relation to activities by members of parliament in their constituencies. The actual social impact of open data is most likely higher than estimated in studies that have attempted to measure it. Some studies only give approximate estimates (for specific countries) of the value resultant from the social impact of open data, given the lack of appropriate framework to make more formalised estimates [34].

6.2 Stewardship and Power

Citizens' ability to participate in governance via open data is reflected in their ability to interpret government performance in relation to trust, integrity, and equity at the public level. For instance citizens' ability to publicly debate at both individual and group levels about a rumored increase in tax prior to the reading of the budget parliament reflects Harrisons view on stewardship and power. [18], noted that, the ability of citizens to public understand and interpret government performance creates the public

value of stewardship/ power. The increase in activities of data journalist's data journalism has created a move by which citizens interpret and understand issues government performance with reference to trust and equity. This has been achieved through the activities Odekro and GLINKS. For instance, activities of Odekro have enabled citizens understand, monitor and electronically participate in parliamentary proceedings through online comments and voting.

6.3 Quality of life and Economic Value

Given the difficulty in measuring transparency and government openness, the most prominent dimension of impact that has been measured is economic impact, with some studies attempting to quantify the financial contribution which open data actually or potentially makes towards economies [34]. This study recognized the possible intertwined relationship between quality of life and economic impact. The activities of famerline, Esoko, Vodafone and data journalism in Ghana has the potential of having an impact on both the quality of life and economic status of Ghanaians. The activities by famerline, Esoko and Vodafone has influenced the wellbeing as well as future and current income of Ghanaians through the provision of mobile apps that leverage on open data to help farmers. The economic value unlocked by open data is typically ascribed to reduced friction in transactions and movements; as well as what economists describes as reducing information asymmetries, increasing allocative efficiency and enhancing network effects. This aspect of created public value responds to the challenge of food security and improving the life of farmers in Ghana. Farmers in Ghana through the use of Open Data by intermediaries can now have tailored real-time information that makes them aware of market prices and best agricultural practices. This does not only create economic value within the agricultural ecosystem but also improvement in the quality of life of the public. Also, the data journalism case study in the Volta Region has impacted on the wellbeing of both mothers and infants. Through the work of data journalists and stakeholders within the Open Data ecosystem in Ghana, Information Systems have been used to improve on the life of local communities.

As noted by some of the farmers: *we can now afford better food, clothing and educate our children, we can sell and get good prices*. In addition, findings form the DSs use of legitimated data noted that there were cases that farmers were unaware of the nutritional value of some of their crops, and hence produced such crops basically as cash crops. *I have forgotten what crop they were selling but the fact of the matter is they were selling the crop. I mean they grow it on their farm, but they actually did not know what it does […]. Because we are talking about a small holder farmer […], okay he is growing it because it is a cash crop right, he is not growing it because he wants to eat it right. OGD enabled us to identify this gap and help them understand the nutritional value of the crop aside it being a cash crop*.

6.4 Strategic Value

Strategic value is interpreted in light of groups or individual's capacity of being innovative for the benefit of others in society [18]. Strategic public value was discussed

from the point of view of impact created economically or politically at both the group and individual levels. This created advantages, opportunities and resources to improve innovation or planning at the individual or group level with the aid of OD. The use of OD led to the development of electronic based innovations such as e-nutrition apps, SMS voice apps, automatic voice recognition, feature inbuilt applications to access solutions. These e-solutions enabled farmers get access to accurate information on right market prices, crop production, nutritional value and weather conditions by using less expensive mobile phones (feature phones).

On the other hand, OD has also given room for groups like data communities and developer communities to develop scalable funded e-solutions. The development of these funded e-solutions also impacted on their economic capital and provided the data communities and developer communities the opportunity to be innovative through the use of OD.

6.5 Leadership

Another impact of Open Data in Ghana is the provision of leadership by the Ghana Statistical Service. This impact is however missing from the adopted framework. Leadership is considered as essential in IS as it influencing the success and integration of IS in the 'value-chain' of organizations [35]. But it is important to have discussions about GODI with other stakeholders within the open data ecosystem. The leadership role provided by Open Data in Ghana should be able to address the challenge of data. Multi-stakeholder discussions are needed to address issues surrounding data sharing culture. This is needed as the attempt to address the culture of lack of data sharing through the introduction of electronic budgeting failed [36]. Despite the public value, it is important to understanding of open data in-terms of its reusability [6]. As this format is lacking in Ghana. This is because the provision of statistical data is mostly referred to as Open Data. There is therefore a need to critical educate the supply-side of the relevance of both and the importance of Open Data and not just statistical figures.

There is also need for collaborations between both supply and demand sides of GODI due to the challenge of data quality. Collaboration in Open Data has been discussed to be essential in process integration and information sharing [37]. Thus pertaining to open data publication and use there is a need to implement the right coordination mechanisms due to its complexity, multi-stakeholder involvement and lack of structure [1]. An agreed upon framework should be drawn that has the potential of increasing data quality from a multi-stakeholder perspective.

7 Conclusion and Recommendations

This research set out to uncover and understand the public value of open data in Ghana. This was achieved by using the public value framework as lens and post-positivist as the paradigm and methodological approach. In addition, the study identified the main supply and demand sides of open data in Ghana. One positive side is the discovery of the activities of the intermediaries in the demand side and the commitment

of the supply side to make data available. These intermediaries include NGOs and data journalist who have leveraged on open data to provide value for citizens.

The implications of our findings to increase the public value of open data are: (1) there is a need to involve the software developers who should be trained on using data to develop apps that can help Ghanaians. This can be done through increase hackathons that are competitive in nature and well-funded to make the applications more scalable, cheap and user friendly. (2) Events like data "equity walk"- training and interactive workshops can be organized on Open Data in Ghana. The data "equity walk" can be used to help Ghanaians understand and interact with data on health, agriculture, elections, education. It should be tailored to be an all-inclusive event; thus, its participants should be all Ghanaians who have prior knowledge on open data and those who do not have that advantage, this will create awareness and increase the impact of open data in Ghana. (3) There is need for commitments and collaborations from all the stakeholders within the GODI ecosystem, to develop an acceptable framework for publishable data in Ghana. This will increase multi-stakeholder discussions on GODI, and this increase the public value. (5) There is need for more and diverse empirically grounded academic research on GODI. (6) This study also recommends the need for intermediaries in the demand side. These intermediaries act as "creators of value positioned between data providers and users" [38]. These intermediaries are essential when there exists a high level of interdependency by multiple stakeholders within complex systems [2].

"*Once people start getting data in formats that are user friendly, accessible, visual it can change perceptions, facilitate discussions on the actual trends, which are sometimes hard to know when we just look at tables and people do not always make economic analysis of the descriptions of the data."*

Future research should focus on developing frameworks that can help measure the data quality in GODI as it is a major challenge affecting its adoption and use in Ghana by the demand side and increase publication by the demand-side players.

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