National Communications Authority

INVITATION FOR COMMENTS: STUDY ON CONTRIBUTION OF ICT/TELECOMMUNICATIONS SECTOR TO GROSS DOMESTIC PRODUCT (GDP) IN GHANA

1. The National Communications Authority (NCA) commissioned a study on the **Contribution of ICT/Telecommunications Sector to Gross Domestic Product (GDP) in Ghana**, to access the worth of the ICT/telecommunications sector to the national economy using the satellite account methodology. The study is now completed and the final report have been submitted by the consultant.

2. Accordingly, in pursuance of its mandate under section 26 and 27 of the Electronic Communications Act, 2008, Act 775 and section 4.1 of the National Telecommunications Policy 2005 (NTP'05), the Authority hereby invites views and comments from Licensed Service Providers, Consumers of Information and Communication Technology services and the General Public on the final report of the study which can be accessed on the Authority's website, **www.nca.org.gh.**

3. The public feedback begins with immediate effect and shall expire on **28th February 2018.**

4. All responses/comments should be electronically transmitted as e-mail attachments, in Microsoft Word format to **info@nca.org.gh** and copy ***research-development@nca.org.gh***

5. All respondents are requested to complete a response cover sheet (see Page II).

6. It would be helpful if your response could include comments on the sections of the document you agree/disagree with.

Confidentiality

7. In furtherance of transparency and openness, the Authority shall consider all responses as non-confidential; accordingly all submissions shall be published on our website, **www.nca.org.gh**, on receipt.

8. Please note that copyright and all other intellectual property in responses shall be assumed to be licensed to NCA to be used to meet its legal requirements.

Issued by the Director General
November, 2017

COVER SHEET FOR RESPONSE TO NCA PUBLIC CONSULTATION ON CONTRIBUTION OF ICT/TELECOMMUNICATIONS SECTOR TO GROSS DOMESTIC PRODUCT (GDP) IN GHANA

BASIC DETAILS

Name of respondent:

Representing (self or organisation/s):

Address:

DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response. It can be published in full on NCA's website, and I authorise NCA to make use of the information in this response to meet its legal requirements. If I have sent my response by email, NCA can disregard any standard e-mail text about not disclosing email contents and attachments.

Name : Signed (if hard copy)

FORMAT FOR COMMENTING ON THE DOCUMENT

Chapter Number	Section Number	Heading	Comments

National Communications Authority (NCA)

Determining the Contribution of the ICT/ Telecommunication Sector to GDP in Ghana

Final Report

June 28, 2017

List of Acronyms and Abbreviations

AGI	Association of Ghana Industries
BPO	Business Process Outsourcing
BVI	Bundled Value Index
c.i.f	Cost, Insurance and Freight
CEPS	Customs, Excise and Preventive Service
CFC	Consumption of Fixed Capital
CMS	Content Management System
CSS	Cascading Style Sheet
CST	Communication Service Tax
EY	Ernst & Young
f.o.b	Free on Board
GCF	Gross Capital Formation
GCNet	Ghana Community Network
GCT	Ghana Chamber of Telecommunication
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GIBA	Ghana Independent Broadcasters Association
GIFEC	Ghana Investment Fund for Electronic Communications
GO	Gross Output
GOS	Gross Operating Surplus
GPRS	Ghana Poverty Reduction Strategy
GRA	Ghana Revenue Authority
GSS	Ghana Statistical Service
GVA	Gross Value Added
HTML	Hyper Text Mark-up Language
IBES	Integrated Business Establishment Survey
IC	Intermediate Consumption
ICOR	Incremental Capital Output Ratio
ICT	Information and Communication Technology
ICT4AD	Information Communication Technology for Accelerated Development
ISIC	International Standard Industrial Classification
ITU	International Telecommunication Union
LTE	Long Term Evolution
MoF	Ministry of Finance
NCA	National Communications Authority
NFSL	National Fiscal Stabilization Levy
NHIL	National Health Insurance Levy
NRI	Network Readiness Index
NSDS	National Strategy for the Development of Statistics
NTP	National Telecom Policy
OECD	Organisation for Economic Co-operation and Development
Rev	Revision
RIA	Research ICT Africa
SMS	Short Messaging Service
SNA	Systems of National Accounts
SUT	Supply Use Table
Telcos	Telecommunication Companies
TOR	Terms of Reference
TRIPS	Total Revenue Integrated Payment System
UNCTAD	United Nations Conference on Trade and Development
VAR	Vector Auto-Regression
VAT	Value Added Tax
VHF	Very High Frequency
WEF	World Economic Forum

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EXECUTIVE SUMMARY

0. Highlights of the Report

0.1 Background and objectives

The Information and Communication Technology (ICT) sector, a relatively young sector in Ghana, has become a burgeoning sector which is expanding the national economy, attracting investment into the country, providing job opportunities and enhancing productivity. However, current computations by the Ghana Statistical Service (GSS) do not appear to incorporate to an appreciable level of detail, the contribution of the growing sub-sectors to its assessment of the sector's contribution to the national economy.

Given the perceived inadequacy of the current estimation system to accurately capture the contribution of the ICT industry, the National Communications Authority (NCA) has procured consulting services to conduct a study to ascertain the contribution of the sector to the Gross Domestic Product (GDP) of Ghana. The study makes use of the concept of satellite systems for national accounting where the scope of investigation is expanded by drawing all relevant areas into the computation. This essentially broadens the core national accounts systems creating a more holistic picture.

The objective of this report is to present all preliminary results as identified and report on the measurement of the contribution of the ICT based industries to the national economy. The results are presented by using five main indicators namely size of the ICT-based industries as a percentage of GDP, investment, employment that the sector generates, foreign trade as well as taxes paid to the government as a percentage of total domestic revenue.

0.2 Methodology and data

In this study, data used for the estimation of the contribution of the ICT sector to the economy was mainly from secondary sources. These include financial statements of players in the sector, customs data and supply use tables (SUT). However, the stakeholder views on ICT policy is primary data.

International standard concepts, definitions and methodologies were used in the collection, compilation and estimation of all variables and indicators. Since ICT is cross-sectoral, using a single method throughout the estimation process would not be possible. Both direct and indirect methods were used in arriving at value added. The direct method involved the extraction of information from financial statements of companies and survey data that have information on gross output and intermediate consumption. Indirect methods were used for estimating value added under two circumstances. Firstly, where output data was available but other relevant information was missing, benchmark ratios from the 2004 SUT was used (with the assumption that the indicator ratios have not changed) to estimate intermediate consumption, trade margins and the value added. The second indirect method used is the commodity flow approach.

Commodity flow approach was used mainly for the wholesale and retail trade value added, applying the trade margin ratios from the 2004 Supply Use Tables (SUT) with Value Added Tax (VAT) data being used for manufacturing and other services.

The tax structure in Ghana is complex with varying taxes for different players in the ICT sector. This made the adoption of a matrix of tax bases linked to the different tax components as the most suitable method to ensure near total tax and levies coverage of the ICT sector.

Employment data was extracted from the database of the first phase of the Integrated Business Establishment Survey (IBES) conducted by the Ghana Statistical Service (GSS).

0.3 Findings

Tables 0.1 and 0.2 provides a summary of findings of the study. Table 0.1 summarises the main indicators of interest. The estimation of Gross Value Added (GVA) for the ICT sector was done for all the years except 2015 as this was not possible due to data limitation relating to some of the activities. Employment figures were obtained from the IBES phase 1 which was conducted in 2014, hence there are no figures for 2015.

Table 0.2 is a summary of forecast figures for the mobile telecommunication industry from 2016 to 2020.

Table 0.1: Summary of findings

Indicator	Indicator Definition	Years					
		2010	2011	2012	2013	2014	2015
ICT GVA	The size of the ICT sector as measured by gross value added	1,411.2	1,674.4	2,069.7	2,292	2,489.3	-
ICT GVA/GDP	The size of the ICT sector as share of national GDP	3.1	2.8	2.7	2.5	2.2	-
Gross capital formation (GCF)**	Value of investments in ICT	1,752.9	558.5	682.8	617.9	890.8	1,005.6
ICT GCF/total GCF	Investment in ICT as share of total investment	14.6	3.4	2.4	2.2	2.7	2.8
Value of ICT imports	c.i.f value of imports of ICT goods	767.4	1,002.6	1,032.2	922.6	1,301.3	1,118.3
ICT Imports/ total imports	Imports of ICT goods as share of total imports	6.2	5.3	4.2	3.7	3.3	2.4
Value of ICT exports	f.o.b value of exports of ICT goods	1.1	13.0	17.6	45.4	17.7	30.7
ICT exports/ total exports	Exports of ICT goods as share of total exports	0.01	0.06	0.06	0.18	0.05	0.07
ICT domestic revenue	Domestic revenues generated by industries in the ICT sector to government	449	688.9	632.6	561.3	867.8	865.3
ICT domestic revenue/ total domestic revenue	ICT domestic revenue as share of total domestic revenue excluding grants	5.9	7.4	4.1	3.0	3.6	2.9
ICT employment/ total employment	Employment in the ICT sector as share of total employment in non-household enterprises	-	-	-	-	1.2	-

*** Covers only the mobile telecommunication industry*

Note: All monetary values are in millions, and ratios (shares) are in percentages; c.i.f = cost, insurance and freight; f.o.b = free on board

Table 0.2: Summary of projections on mobile telecommunication industry

Type of Service	Indicator	Baseline 2015	Forecast				
			2016	2017	2018	2019	2020
Voice	Subscription** (million)	35.0	38.7	42.1	45.6	49.0	52.5
	Traffic (billion minutes.)	43,518,934	51,602,976	57,218,466	63,330,087	69,937,837	77,041,720
Mobile data	Subscription** (million)	18.1	22.6	26.6	30.5	34.4	38.3
	Traffic (Tb)	33,565.9	61,859.8	91,883.3	124,801.2	159,647.6	195,779.0
LTE data	Subscription	-	109,729++	123,576	136,828	150,080	163,332
	Traffic (Tb)	-	11,165.8++	15,017.6	18,683.7	22,349.8	26,015.9

*** End of December figures*

++ Baseline

0.4 Conclusions and recommendations

In order to determine the contribution of ICT/Telecommunications sector to GDP in Ghana, this study covered a series of activities that culminated into an end product, which could be described as a supply-side satellite account. Concepts, methods, and definitions for this study are based on existing international statistical standards. The indicators of interest and key findings' focus for this study, with reference years 2010 – 2015, include the contributions to GDP, capital formation, foreign trade (imports and exports), employment and domestic revenue as well as forecasting of the growth of telecommunications from 2015 to 2020, with 2015 as the base year.

Based on our findings, ICT contribution to GDP was highest in 2010, and continuously declined over the referenced years. Indeed, except for domestic revenue, with the highest contribution to the economy in 2011, all the other indicators showed high impact in 2010 and then tapered. Disaggregating by components, the study noted that telecommunication sub-sector contributed more to the ICT sector than the other components such as manufacturing, wholesale and retail trade, and other services. Additionally, the share of ICT in Information and Communication shows plausible underestimation of the sector in the published GDP. This is supported by the fact that the ICT GVA component is larger than the related sector's GDP.

Projections for the contributions of ICT to GDP could not be estimated; due to inadequate number of years, and hence data points, available for use in this study. However, a focused study of the telecommunications sector allowed for some level of prediction for voice subscription and traffic; data subscription and traffic; and long-term evolution (LTE) subscription and LTE data usage. The primary reason for the choice of these services is the availability of sufficient data points to make meaningful predictions. Besides, it could help NCA to plan and budget, evaluate, and guide future validation effectively. A forecast of the telecommunication services suggests average annual growth of mobile data subscription and traffic by 16.2% and 42.3% respectively between 2015 and 2020. Voice subscription will, however, record a lower annual growth of 8.6% over the same period. The forecast figures for subscription and traffic provide relevant sources of information, as well as a possible guide for the NCA to achieve Ghana's ICT objectives which include promotion of development of the national ICT infrastructure; promotion of the use of ICT in all sectors of the economy; and the provision of affordable broadband for all Ghanaians by 2020.

Internationally, few countries have compiled satellite accounts on the ICT sector. In Africa, South Africa is known to have compiled ICT satellite account in 2012. The level of development of the ICT sector in Ghana, though comparable to South Africa for some indicators, is below par with that of countries like Malaysia.

INTRODUCTION

1. Background

According to the Africa Market Output Report (2015), Ghana has one of the fastest growing telecom industries in Africa, being ranked among the top 5 in the Sub-Saharan region with respect to market size and potential for further growth. Consequently, support services provided by telecommunication service providers and distributors (retailers and wholesalers) have also increased as the demand for their services keep growing. The broadcasting industry is also growing rapidly as seen by the increase in radio and television stations. This heightened activity of the sector is expanding the national economy, attracting investment into the country, providing job opportunities and enhancing productivity.

The Gross Domestic Product (GDP) is the monetary value of the finished goods and services produced within a country's borders in a specific time period, often calculated on an annual basis but may also be calculated on a quarterly basis. It comprises public and private consumption, government outlays, investments and trade balances. In a nutshell, the GDP is an indicator of the nation's overall economic activity. The estimation of the GDP is done in stages, with estimates generated at each stage being dependent on source data available. In Ghana, GDP is calculated using both the expenditure and the production methodologies on an annual basis and computed using the production approach on a quarterly basis.

With the growing number of players in this industry, previous estimations of the contribution of the telecommunication and broadcasting industry to GDP do not seem to provide an accurate picture as the industry has grown significantly over the last 8 years. As such it has become necessary for the National Communications Authority (NCA) to procure consulting services to conduct a more extensive analysis of the contribution of the industry to GDP.

1.1 Context

Since the liberalization of the communications industry in Ghana during the early 1990s, the industry has grown and become competitive with 6 international mobile telecommunications (telecoms) service providers, 3 fixed telephone companies[1] (with 2 in operation), 3 tower companies, 10 domestic fibre optic companies, 5 international submarine cables, 4 broadband wireless access providers (with 3 in operation), over 30 internet and data service providers and more than 400 broadcasting entities (radio and TV) as at the end of 2015.

In the year 2010, while all the mobile operators were accounted for, information on less than 20% of the 196 radio stations was made available for inclusion in the computation of the sector's contribution to GDP as estimated by GSS. Furthermore, most of the internet and data service providers were also not part of the contribution of the sector to GDP. The GSS estimates that on average, the contribution of the communications sector to GDP is between 1.3% and 2.6%.

With the growth and income generation of this sector, it has become necessary to review existing contribution estimates of the sector to GDP. In addition, it is important to study the overall contribution of the ICT sector to the Ghanaian economy in terms of how it has contributed to government's revenue generation, investment, trade and employment.

Thus, Ernst & Young (EY) was contracted by NCA to produce a more rigorous and well documented analysis of the contributions of the ICT/Telecommunications sector to GDP and the economy as a whole. The findings of the study, which is part of the NCA's broader initiative to contribute to the National Strategy for the Development of Statistics (NSDS), is expected to help the NCA assist GSS in using reliable and comprehensive data for

[1] MTN obtained a fixed telephone license from the NCA in 2015, however they are yet to commence commercial operation.

estimating the contribution of ICT/Telecommunications sector to GDP as well as capacity building and knowledge transfer to the NCA.

1.2 Objective and scope of report

The main objective of this study is to determine the contribution of the ICT/Telecommunication sector to GDP in Ghana. As follow-up to the issuance of the Final Draft Report, this Final Report presents the findings of the study by:

1. Stating clearly trends observed; emphasizing comparisons over time.
2. Illustrating the dynamics of the industry.
3. Highlighting developments in the different industry groups with emphasis on previously underestimated sub-sectors.
4. Providing tables to summarise all results generated.
5. Reflecting comments and suggestions provided by the NCA (the client) and key stakeholders.

To adequately capture the sector, the study identifies the relevant industry activities and categories of economic activities as well as follows the approach and methodology described in earlier reports.

The organisation of this report is sub-divided into 4 categories; The Introduction provides a general introduction of the sector as well as the NCA. Approach and Methodology expounds on the various procedures and processes that the study followed in reaching the results generated. Findings presents the results of the study whereas Conclusion and Recommendations summarizes the study and provides recommendations based on our findings and consultations with key players in the industry.

1.2.1 Scope limitations

This assignment is being carried out with a view to meeting the agreed objectives above with the following limitations:

1. The procedures we performed do not constitute an audit or a review in accordance with International Standards on Auditing or International Standards on Review Engagements (or relevant national standards or practices). Consequently, we do not express any audit assurance.
2. The scope of our work was limited to an analysis of documentation and information made available to us and specific enquiries undertaken to pursue our mandate. Accordingly, we do not express any opinion on the information contained in the results.
3. Conclusions and recommendations made in this report are based on the assumption that the information provided to us is correct and accurate. We have relied upon and assumed, without independent verification, the accuracy and completeness of any information provided to us, and accordingly we express no opinion or make any representation concerning the accuracy and completeness of any such information.
4. This report and annexures are strictly private and confidential, and are intended solely for the information and use by NCA and GSS.

5. This may not be disclosed to third parties without prior written consent. Ernst & Young assumes no responsibility to any user of the results other than NCA and GSS. Any other persons, who choose to rely on the results, do so entirely at their own risk.

6. Third parties agree to indemnify and hold harmless Ernst & Young and its personnel from any claim by or any other third party to the extent that such claim arises as a result of Ernst & Young permitting access to its results in connection with this engagement.

7. Our procedures, findings and conclusions have been directed solely towards complying with your instructions set out in the Scope of Work. We would therefore emphasise that the issues raised in this report cannot be considered exhaustive and that there is some risk that had we been required to undertake a more extensive exercise, we might have identified other issues that would be of relevance to you.

8. If additional or new documentation or information is brought to our attention subsequent to the date of this report, which would affect the results of our engagement detailed below, we reserve the right to amend and qualify our report accordingly.

2. Overview of NCA and Ghana's ICT Sector

The National Communications Authority (NCA) is the regulatory body responsible for all communication related activities in Ghana with its vision and mission as follows;

Vision: The vision of the NCA is to be a world-class regulator that facilitates innovative, reliable and sustainable communication solutions to meet stakeholders' expectation.

Mission: The mission of the NCA is to regulate the communications industry in a forward-looking and transparent manner that promotes fair and sustainable competition, stimulates innovation, encourages investment, protects stakeholders' interest and facilitates universal access to quality communication services for national development. It does this by keeping to the strictest conditions of service, holding all service providers accountable for their activities in Ghana.

ICT is a very broad area as is explained in detail throughout the report. As there is not one agreed definition, the exact confines of ICT are either narrowed or broadened depending on the task at hand. For this study, the definition of ICT follows that of the Organisation for Economic Co-operation and Development (OECD) 2009 while adopting the fourth revision of the International Standard Industrial Classification (ISIC) for the identification of establishments.

While the ICT industry is a prolific industry, it is still being developed in Ghana with some aspects of ICT barely developed. Currently, the major sub-sector of the industry in Ghana is the telecommunications sub-sector.

2.1 Overview of the NCA and its activities

2.1.1 Legal framework

The NCA is the body mandated by law to license and regulate communications activities and services in the country. The NCA was established in 1996 by Act 524 to regulate communications by wire, cable, radio, television, satellite and similar means of technology for the orderly development and operation of efficient communications services in Ghana and to provide for related purposes. Pursuant to the powers of the Board as provided in Act 524, the National Communications Regulations, 2003, L.I. 1719 was enacted to give effect to the provisions of Act 524.

In 2008, Act 524 was repealed and replaced with the National Communications Act, 2008, Act 769 which re-established the NCA as the central body mandated to regulate the communications services in the country.

In the same year, the Electronic Communications Act, 2008, Act 775 was promulgated to provide for the regulation of electronic communications, the regulation of broadcasting, the use of the electro-magnetic spectrum and for related matters. Act 775 has seen several amendments since its promulgation. The first is the Electronic Communications (Amendment) Act, 2009, Act 786 which amends the Act 775 to provide a minimum rate for international incoming electronic communications traffic and for related matters. The second amendment is the Electronic Communications (Amendment) Act, 2016 (Act 910) which provides for clearing house services through the establishment and operation of Interconnect Clearinghouse.

In exercise of the powers conferred on the Minister responsible for Communications by Section 97 of the Electronic Communications Act, 2008, (Act 775) the Electronic Communications Regulations 2011, L.I. 1991 was enacted.

Act 769 mandates the Authority to undertake research and development work related to its functions and promote research and the development by other persons of the communications industry. The NCA further to its mandate under Act 775 periodically issues directions to service providers, network operators or persons holding frequency authorization to make returns or furnish documents to the Authority for statistical or regulatory purposes. The data collected from such exercise aids the Authority in the discharge of its regulatory mandate.

2.1.2 Organisation of the NCA

The NCA is a multifaceted organisation with nine functional divisions. Each division has at the core of its activities specific responsibilities to enable the Authority run smoothly. The divisions in place per the organisation structure as at the last quarter of 2016 include:

- Consumer and Corporate Affairs
- Engineering
- Finance
- Human Resource and Administration
- Legal
- Monitoring and Compliance
- Policy, Strategy and Innovation
- Regulatory Administration
- Research and Business Development

Being the sole agency backed by law, the NCA's responsibilities include but not limited to the following:

- Advisory: Advises the Minister of Communications on local and international communication issues and policies that affects the sector as well as implement policy directives from the Ministry of Communications.
- Licensing and Authorization: Issues licenses, establishes terms and conditions for all electronic communication services and maintains a register of licensees, authorization holders and interests of board members.
- Regulatory: Ensures fair competition, sets national communication standards, regulates traffic, establishes and monitors quality of service indicators for operators and service providers.

The NCA, in its quest to maintain international standards, monitors the quality of services provided by the telecommunications sub-sector by using indicators like the call completion rate, call congestion rate and the call drop rate. However, there is minimal intervention by the NCA in support services such as hardware manufacturing and distribution. For these areas, the NCA issues an 'equipment type approval' and carries out random market surveillance activities to assess the quality of ICT-related goods being sold on the market.

2.1.3 Funding and revenue sources

NCA has the mandate to charge fees (levies and taxes) across the sector for various services and authorizations. These levies and taxes help generate revenue for the running of the Authority. They include:

- Funds provided by Parliament
- Funds approved by the Minister of Finance
- Donations, grants and gifts
- Revenue derived from the investment of the Authority's funds
- Fees, charges or any other moneys payable. These include licensing, regulatory fees, microwave links, international gateway, broadcasting and other services

2.1.4 Key stakeholders

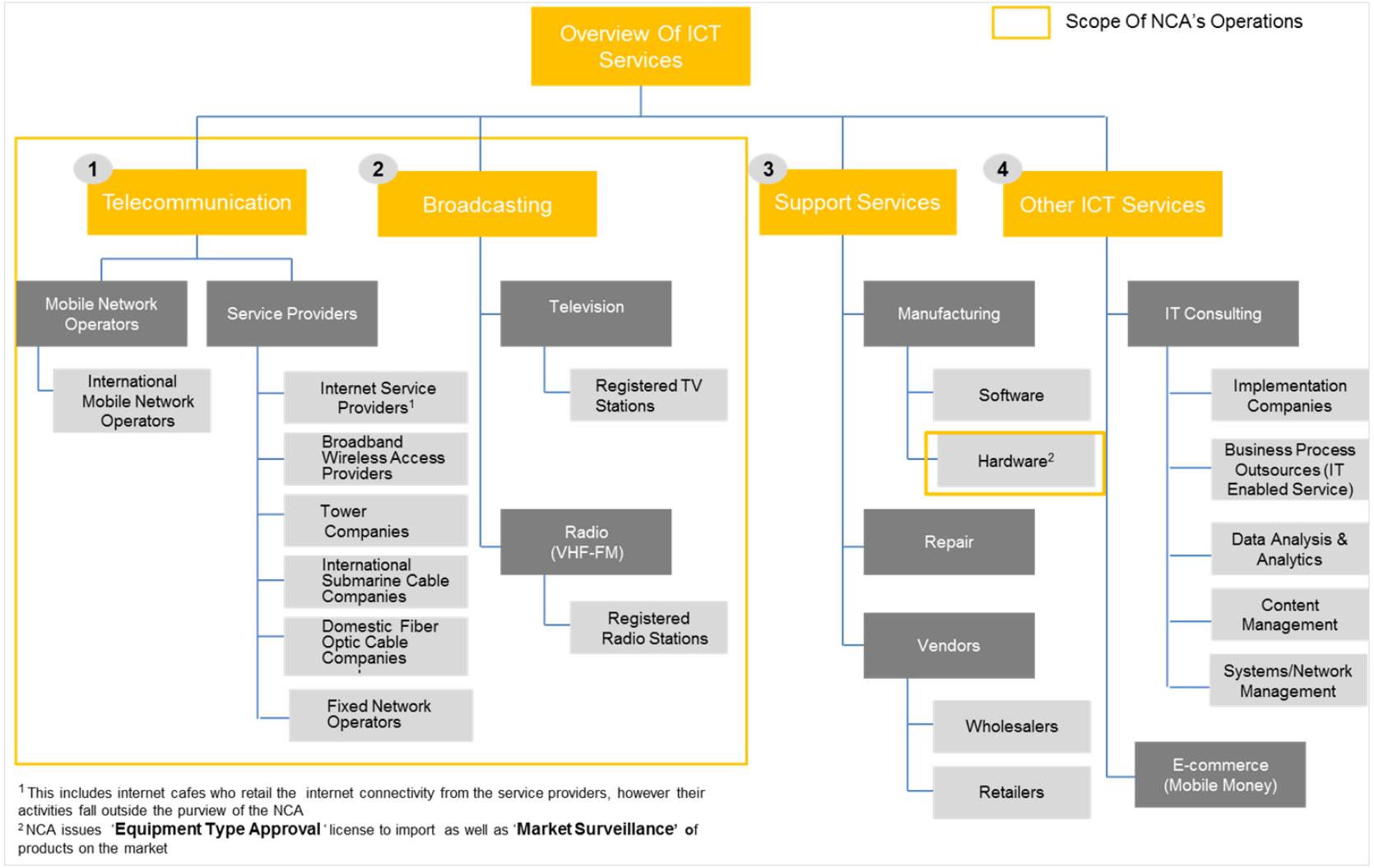
For the purpose of this study, key stakeholders are considered as the persons or organisations that have an interest in the NCA and can be affected by the NCA's actions, objectives and policies. The stakeholders engaged include the Ghana Statistical Service (GSS), Ghana Revenue Authority (GRA), as well as associations such as the Association of Ghana Industries (AGI) and the Ghana Chamber of Telecommunications (GCT).

The NCA was established to operate under the Ministry of Communication. While the NCA has the mandate to run on its own, to sue and be sued in its own name, the Authority is accountable to the Minister to which end an annual report has to be submitted to the Minister not exceeding 30 days after the final audit report is received.

Under the vision statement of the NCA, the Authority seeks to meet stakeholder expectations by facilitating innovative, reliable and sustainable communication solutions. From the roles and responsibilities of the Authority, there is an exhaustive list of stakeholders with forward and backward linkages.

The list encompasses the consumers, telecommunications, broadcasting and support service sub-sectors. While ICT is very broad, the NCA is mandated to have purview over the telecommunication and the broadcasting sectors. The players in these sectors are the most direct stakeholders with some support services also indirectly under the purview of the NCA. Figure 1 provides a general overview of the ICT sector in Ghana highlighting the scope of the NCA's operations.

Figure1: Overview of ICT Services in Ghana



[1] This includes internet cafes who retail the internet connectivity from the service providers, however their activities fall outside the purview of the NCA

[2] NCA issues '**Equipment Type Approval**' license to import as well as '**Market Surveillance**' of products on the market

2.2 Definition of ICT

There are different definitions of the ICT sector, and the existence of a widely-accepted definition of the sector is the first step towards making meaningful comparisons across time and countries possible. The definition of ICT while seemingly straightforward is very intricate as there are various aspects that may be included in one definition but excluded from another as shown by the various classification schemes.

The most widely accepted and used definition of the ICT sector is the one by the Organisation for Economic Cooperation and Development (OECD). It defines the ICT sector as the sector producing either ICT manufactured products or ICT services.

More specifically, the OECD member countries agreed to define the ICT sector as a combination of manufacturing and service industries that capture, transmit and display data and information electronically. This definition, based on the fourth revision of the International Standard Classification of Activities (ISIC Revision 4), provides a statistical basis for the measurement, in an internationally comparable way, of that part of economic activities that is generated by the production of ICT goods and services. The production of goods and services, of a candidate industry must primarily be intended to fulfil or enable the function of information processing and communication by electronic means, including transmission and display.

2.3 Ghana's ICT sector

With the world becoming increasingly interconnected, the role of ICT has become more pronounced. Many countries around the world have established organizations for the promotion of the ICT sector with Ghana being no exception, as seen by the establishment of the National Communications Authority (NCA).

As noted earlier, the ICT sector in Ghana encompasses the telecommunication industry, the broadcasting industry and the support service providers. While the telecommunication and broadcasting sub-sectors account for a larger percentage of the sector with respect to visibility and coverage, the support service base keeps increasing with a growing inventory of ICT related activities. Software developers and retailers branching into e-commerce under the relatively new mobile money platform is an example of the expanding group of support services.

According to Mastrini and Aguerre (2009), policies with clear cut implementation are essential to create a conducive environment for stability, predictability and fair competition at all levels, allowing for universal service and other obligations to be met. This highlights the importance of relevant policies for the stimulation of growth in the industry.

In Ghana, the two major policies that are driving ICT developments are the ICT for Accelerated Development (ICT4AD) Policy and National Telecom Policy (NTP). The ICT4AD Policy, supported by the United Nations (UN), aims to support an ICT-led socio-economic development process aimed at transforming Ghana into a middle income, information-rich and knowledge-based society. The development of this policy framework was based on a nation-wide consultative process involving key stakeholders in the public sector, private sector and civil society. This policy takes into account key socio-economic development

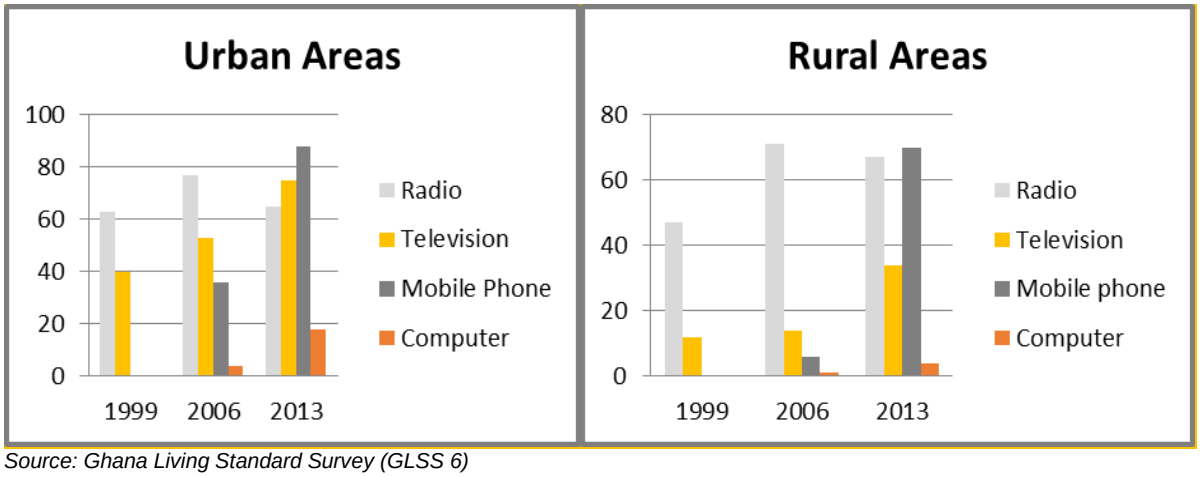
framework documents such as the Ghana Poverty Reduction Strategy (GPRS), Vision 2020 and the Co-ordinated Program for Economic and Social Development of Ghana.

The goal of the NTP is to establish market structures that will be most beneficial to businesses and the Ghanaian citizenry, setting in motion the procedures and incentives to boost the market's development as well as support the realization of the vision of the national ICT4AD policy.

Great strides have also been made in promoting ICT in the rural areas by the Ghana Investment Fund for Electronic Communications (GIFEC). GIFEC is a fund set up by the Government of Ghana established under the Ministry of Communications to facilitate the provision of access to ICT, internet connectivity and communications infrastructure to underserved and unserved areas in Ghana. Through projects and joint collaborations with private organizations, efforts have been made to bring about development in the rural areas. This may account for the increase in ownership of mobile phones in the rural areas from 6% in 2006 to 70% in 2013.

Figure 2 shows the rate of ownership of ICT assets over a 15-year period (1999 – 2013) in rural and urban settlements. While efforts made to bridge the gap between the rural and the urban areas have been successful in some regard, more work needs to be done in other areas such as computer ownership as shown in Figure 2 by the relatively lower adoption rates.

Figure 2: Household ownership of ICT assets in rural and urban areas



Source: Ghana Living Standard Survey (GLSS 6)

According to the Data Development Group of the World Bank, ICT infrastructure development in Ghana is progressing at a faster rate compared to other low-income countries and is above the 1.1% average for Sub-Saharan Africa. The improvement of the macroeconomic environment by creating an avenue for sustainable growth and development has helped promote the ICT industry in Ghana.

2.4 Ghana's major ICT sub-sectors

2.4.1 The Telecommunication sub-sector

Ghana has one of the fastest growing telecom industries in Africa with a voice subscriber density of over 100% and internet data of over 40%. Mobile telephone subscriber base was a little over 100,000 in 1997 shooting up to 25.9 million in 2012[2].

Ghana's telecommunications infrastructure was laid down and expanded by the colonial administration mainly to facilitate the economic, social, and political administration of the colony with 1,492 miles of telegraph lines constructed to link 48 telegraph offices spread throughout the country by the end of 1912[3]. In 1953, the first automatic telephone exchange with 200 lines was installed in Accra to replace the manual one erected 63 years earlier. Three years later, in 1956, the trunk lines connecting Accra, Kumasi, Takoradi, and Tamale were upgraded through the installation of a 48 and 12 channel VHF network.

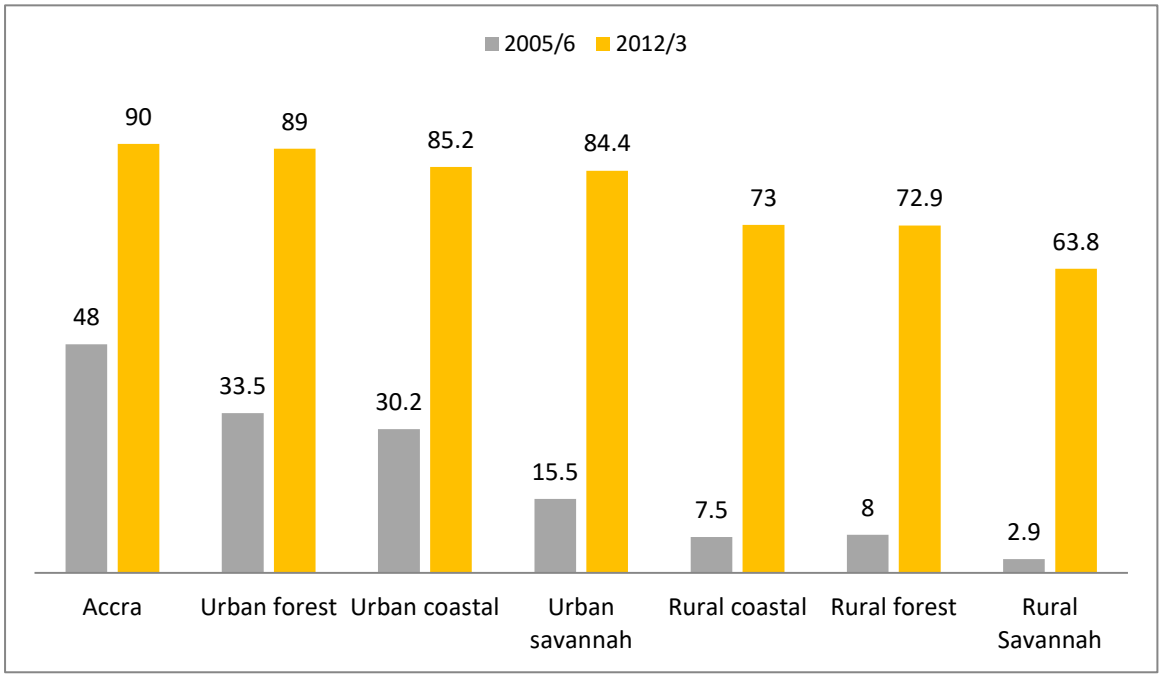
The attainment of independence by Ghana in 1957 spurred the telecommunications development. A seven-year development plan launched just after independence hastened the completion of a second automatic exchange in Accra in 1957. By the end of 1963, there were over 16,000 telephone subscribers and 32,000 rotary-type telephones in use in Ghana.

Since launching the first cellular mobile network in sub-Saharan Africa in 1992, a new dynamism has been seen with the telecommunications sub-sector becoming fiercely competitive. As at December 2015, there were 6 international mobile telecommunications service providers, 3 fixed telephone companies (with 2 in operation), 4 broadband wireless access providers (with 3 in operation), over 30 broadband internet and data service providers, 3 tower companies, 5 international submarine cable companies and 10 domestic fibre companies.

With ICT markets witnessing unprecedented rates of growth most likely due to the adoption of internet-based services and wireless technologies, there has been a sharp increase in usage of mobile phones across rural and urban locations.

[2] Figures were sourced from the NCA 2012 Annual Report.
[3] Ghana's telecom history was sourced from Allotey F.& Akorli F. on Telecommunication in Ghana.

Figure 3: Mobile phone ownership by geographical location



Source: Ghana Living Standards Survey round 6

From Figure 3, we observe large increases in mobile phone ownership with the deviations between rural and urban regions relatively insignificant as compared to other ICT related products.

The Licence Conditions of Operators stipulate that call drop rates should be less than 3% of all call attempts. Through the efforts of the NCA, the quality of service[4] has increased significantly with call drop rate across networks at an average of 0.81% and a drop in the call congestion rate from 4% recorded in 2010 to 1.19% in 2012.

2.4.2 The Broadcasting sub-sector

The broadcasting industry also experienced rapid growth over the last two decades. As at the fourth quarter of 2015, the NCA had licensed 412 radio operators with 313 in operation across the country. Table 1 shows the number of radio stations registered with the NCA over two decades.

Table 1: Number of authorized radio stations

Region	1990-1999	2000-2009	2010-2015
Ashanti	12	23	25
Brong Ahafo	8	19	31
Central	4	15	12
Eastern	3	17	18
Greater Accra	15	27	15
Northern	7	12	25
Upper East	2	6	10
Upper West	1	4	12
Volta	5	9	31

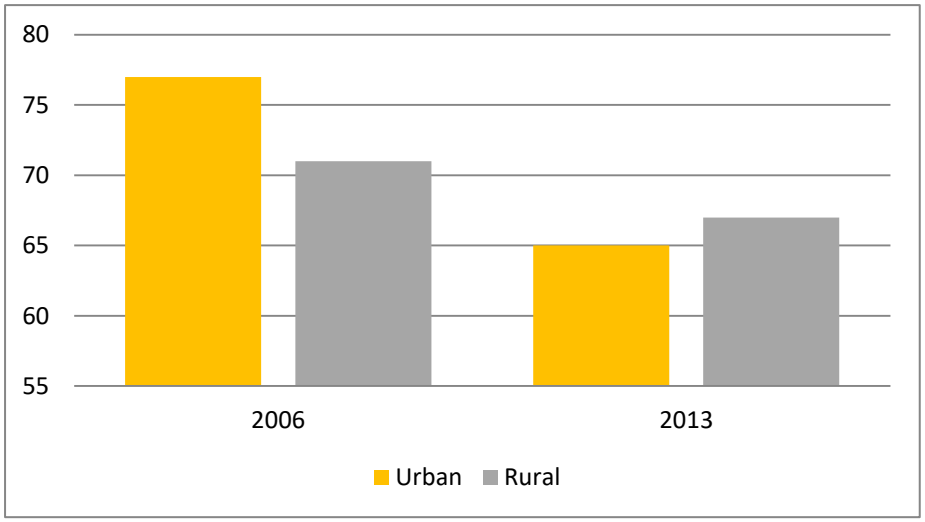
[4] Quality of service taken as quoted in the annual report of the NCA.

Region	1990-1999	2000-2009	2010-2015
Western	8	21	43

Source: National Communications Authority

While there was a noticeable decrease in the ownership of radio sets from 2006 to 2013 as shown in Figure 4, it did not necessarily affect the growth of radio stations in operation. This is most likely due to the increase in ownership of mobile handsets which come equipped with radio facilities.

Figure 4: Radio set ownership in rural and urban areas



Source: Ghana Living Standards Survey round 6

Broadcasting activities are not limited to radio but are also captured by television. There has been a growth in the television sector with 93 authorised television stations with 51 currently on air. This growth is further validated by the increase in the different types of television services available to viewers. The analogue system is also gradually being phased out with the NCA suspending the issuance of new analogue licences in accordance with international conventions. Table 2 summarises the different types of television services available as at December 2016.

Table 2: Authorised television stations by type of television service

No.	Type of Television Service	Total No. of Authorised Stations
1	Analogue Terrestrial Television	21
2	Digital Terrestrial Pay Television (Service only)	1
3	Digital Terrestrial Pay Television (Service and Frequency)	5
4	Digital Terrestrial Free-To-Air Television Programme Channel	11
5	Satellite Television Broadcasting (Pay TV Direct-To-Home Bouquet)	7
6	Satellite Television Broadcasting (Free-To-Air Direct-To-Home Bouquet)	8
7	Satellite Television Broadcasting (Free-To-Air Direct-To-Home Single Channel)	39
8	Digital Cable Television	1
Total number of authorised TV stations		**93**

Source: National Communications Authority (NCA)

While there were 93 authorised television stations as at the fourth quarter of 2016, only 51 were on air accounting for less than 60% of the authorised stations. Various reasons such as technical issues and/or high operational costs, may account for this phenomenon, nonetheless there has been a massive increase in the ownership rates of television sets in both rural and urban regions with higher rates understandably in the urban areas.

2.4.3 The software development sub-sector

While software development is a process of writing and maintaining source codes, in a broader sense, it includes all the processes that are involved from the conception of the desired software through to the implementation of the software. Therefore, software development may include research, new development, prototyping, modification, reuse, re-engineering, maintenance, or any other activities that result in software products.

Currently there is a growing number of software development companies as the demand for their services keep increasing due to the ever-increasing automation/streamlining of processes. A number of individuals also develop software as this sub-sector is relatively unregulated making it difficult for the government to generate the appropriate revenue or accurately assess the value of the sub-sector.

There are a number of different types of software development companies. While software development in Ghana may not be exclusively limited to one particular type of service provision due to the underdeveloped nature of the market, most software developers fall under at least two categories: website development companies and retailers adapting existing software applications from international companies where necessary.

These categories[5] include:

- Bespoke companies: These companies offer services at the specific request of a company or survey the market and meet particular needs based on their assessment of the needs of the market. These services are usually in the form of solutions to address specific gaps in their clients' processes.
- Consulting companies: These are companies that build web, mobile and desktop applications for businesses and get paid for it. They either have the skill set to do so in-house or outsource the project to another company/team in-country or outside the country and oversee its' life-cycle. These companies tend to be implementation companies or carry out some form of content management.
- Retailers: These companies typically partner bigger software companies and serve as agents or distributors in the country. Such companies do not develop their own software, but front for other businesses which may be local or international. A large number of software developers in the country fall under this section exclusively or in some combination with other services.
- Sector focused/specific service oriented: These companies occupy a niche in the industry and often stick to their relevant areas of expertise. They usually have their own engineering teams who design and build their own software, fix bugs, manage and update them. A more extended version of these are the sector focused companies who build specific applications for specific scenarios or sectors such as gaming, health, customer service, payment, and the like.

[5] The classifications are informed by consultations with various players in the software industry as well as extensive research on the sub-sector.

- Website development companies: These companies build websites for clients. Some of the sites range from simple static HTML/CSS websites through static websites to more interactive sites with some kind of content management systems which make it easier for the client to manage and edit their own content. Some of the CMS platforms popular in this space are Drupal, Joomla, WordPress and Modx.

According to the software developers who were engaged, some software development companies would prefer to be sector focused in order to deepen their capabilities in specific areas. However, the underdeveloped nature of the industry poses significant constraints on them, leading to the acceptance of virtually all service requests they receive. To meet certain specific requirements, software developers procure the services of subject matter experts from third party organisations as and when required.

2.4.4 The support services sub-sector

The support services sub-sector is a term that encompasses all the sectors that aid in the smooth operation and/or distribution of the products produced by the telecommunications, broadcasting and software development sub sectors.

Being complementary to the other sub-sectors, the heightened activity of the other sub-sectors has created the demand for this sub-sector. The companies operating in this sub-sector may be classified as follows:

- Service providers: These companies mainly undertake services that aid the activities of the other sub-sectors. Support service providers such as tower companies, optic fibre companies and sub-marine cable companies are also increasing in number. As at December 2015, there were 3 tower companies, 10 domestic fibre optic companies, 5 international submarine cables and 3 broadband wireless access providers supporting the ICT industry.
- IT support providers: These companies offer support services to the ICT industry. Repairers come under this category and offer maintenance checks and repairs. In Ghana, individuals and smaller companies direct all ICT related issues to these IT support companies whereas larger companies have some form of in-house IT department that handle any issues that may arise on a daily basis.
- Manufacturers: Manufacturing is the process through which raw materials are transformed into final products. These final products may be sold to other manufacturers for the production of more complex products or assembly. In Ghana, most ICT related manufacturers only engage in the assembling and not the manufacture of the actual hardware.
- Vendors: These companies include retailers and wholesalers of ICT related goods. There are a large number of vendors who deal exclusively in one particular ICT related product, a range of ICT related goods and a combination of non-related ICT related goods such as consumables with ICT related goods. This is a burgeoning area due to the growing demand of the sector.

2.5 Prospects of Ghana's ICT Sector

In every organisation, research and development is vital for sustainable growth and development. The introduction of a vibrant research and business development division at

the NCA is a step in the right direction as increased research into the industry will lead to more creative and adept solutions which will in-turn further increase the productivity and growth of the industry.

In comparison with other African countries, Ghana outperforms most countries in the West African region and is in very good standing in the entire African region. Under the World Economic Forum's Network Readiness Index (NRI), Ghana ranked 95th for the year 2013. Table 3 describes the use of ICT by different sectors as well as the readiness to use available technologies.

Table 3: Selected African Countries Performance by the NRI

Country	NRI Ranking	Environment	Readiness	Use			
				Overall	Government	Business	Individual
South Africa	70	33	95	72	102	33	81
Rwanda	88	29	116	107	59	67	139
Kenya	93	98	110	84	44	53	115
Ghana	***95***	***64***	***101***	***102***	***89***	***103***	***102***
Botswana	96	56	107	99	91	96	98
Uganda	110	88	104	117	84	106	131
Namibia	111	58	115	101	116	76	99
Nigeria	113	94	123	108	113	68	111
Cameroon	124	119	131	119	101	98	130
Tanzania	127	108	135	120	99	102	127
Ethiopia	128	104	140	130	83	140	143
Mozambique	133	120	143	128	106	125	141

Source: World Economic Forum (2013)

In leveraging ICT to boost competitiveness, innovation and wellbeing as detailed in the policy frameworks, Ghana's performance measured by the World Economic Forum's Network Readiness Index (NRI) has steadily been declining. Table 4 shows Ghana's performance over the last 4 years where Ghana has maintained an average score of 3.5[6]. However, it should be noted that even with the deteriorating ranking on the NRI, Ghana placed 1st in the West African sub-region.

Table 4: Ghana's Performance by the NRI

Year	Position
2013	95th
2014	96th
2015	101st

Source: Global Information Technology Report 2015

Prepaid pricing index is another assessment indicator of telecommunications performance across countries. Research ICT Africa (RIA) applies OECD usage basket for prepaid products based on minutes, SMS and data tariff capturing the monthly basket cost. The Bundled Value Index (BVI) measures the value a customer gets for bundled minutes or SMSs and data per month. Thus, the BVI complements this as it calculates the value for the blended bundle, beyond monthly basket cost. Based on the above methodology, Table 5 shows the African prepaid pricing index for the first quarter of 2015. Ghana ranks fourth by this criterion, also showing that Ghana is in good standing as compared to other African countries.

[6] The NRI is measured on a scale of 1 through 7 with 1 being the worst and 7 being the best.

Limitations of the industry are most readily linked to availability of data to carry out appreciable analysis that will aid the formulation of appropriate policies to meet the growing needs and concerns of the industry.

Table 5: 2015 First Quarter African Prepaid Pricing Index

Country name	Cheapest product			
	Dominant operator		Cheapest in country	
	USD	Rank	USD	Rank
Kenya	1.67	1	1.67	2
Sudan	2.21	2	1.38	1
Egypt	2.81	3	2.81	3
Ghana	*3.02*	*4*	*2.79*	*4*
Ethiopia	3.53	5	3.53	5
Mauritius	3.32	6	3.32	6
Rwanda	4.69	7	4.69	9
Tunisia	4.94	8	4.69	13
Nigeria	5.63	9	3.90	8
Tanzania	5.77	10	4.51	12
Uganda	6.30	11	6.30	15
Namibia	7.41	12	7.41	16
Libya	6.68	13	6.68	18
South Africa	7.65	14	4.62	10
Algeria	8.63	15	8.63	20
Botswana	8.71	16	7.05	17
Benin	8.12	17	8.12	21
Sierra Leone	13.08	18	10.61	22
Niger	9.09	19	9.09	23
Burkina Faso	9.51	20	9.51	25
Mozambique	10.00	21	10.00	26
Liberia	10.48	22	10.48	33
Mali	10.93	23	10.93	34
Central African Republic	11.50	24	11.50	35
Malawi	13.00	25	10.95	27
Cote d'Ivoire	11.64	26	11.64	36
Lesotho	12.70	27	10.87	30
Seychelles	13.80	28	13.80	37
Congo Brazzaville	12.37	29	10.55	32
Sao Tome and Principe	12.72	30	12.72	38

Source: Research ICT Africa

APPROACH AND METHODOLOGY

3. Approach and Methodology

Measuring the economic contribution of the ICT sector implies studying the activities of the multiple actors of the sector such as the service operators, the distributors, the equipment manufacturers, and wholesalers and retailers. Thus, to correctly capture an accurate measure of the contribution of the sector, the scope of analysis needs to be widened enough to incorporate all measurable activities. This necessitates the use of satellite systems of national accounts[7].

An ICT satellite account involves the identification of ICT products and activities within the national accounting framework to aid the production of a comprehensive and coherent set of economic data on ICT supply and use. The study therefore adopted the 2009 OECD ISIC Rev. 4 grouping of ICT sector activities into ICT manufacturing industries, ICT trade industries, and ICT services industries, as shown in Table 6.

Broadcasting activities have been classified under 'Content and Media' outside the ICT sector in the OECD definition. However, the International Telecommunications Union (ITU) includes broadcasting as part of the ICT group. To adequately estimate the contribution of all the sub-sectors the NCA regulates, the study included the two activities under the "Programming and Broadcasting Activities" sector, namely "Radio broadcasting" (ISIC 6010) and "Television programming and broadcasting activities" (ISIC 6020). These categorisations come under the broadcasting section of the ITU which is part of the ICT group.

3.1 Identification and classification rationale and strategies

The first step in measuring the contribution of a sector is to define the activities that come under the sector. Given that ICT is a general-purpose technology, official statisticians had to carve ICT into several facets amenable to statistical enquiries. Implementing the OECD definition, the principles underlying the identification are as follows:

For manufacturing industries, the products of a candidate industry must:

- Be intended to fulfil the function of information processing and communication including transmission and display.
- Use electronic processing to detect, measure and/or record physical phenomena or control a physical process.

For service industries, the products of a candidate industry must:

- Be intended to enable the function of information processing and communication by electronic means.

This study has adopted the OECD (2009) definition and on that basis, the following general principle (definition) is being used to identify ICT economic activities (industries): "The production (goods and services) of a candidate industry must primarily be intended to fulfil or enable the function of information processing and communication by electronic means, including transmission and display".

Table 6: 2009 OECD ICT Industries ISIC Rev 4 groupings

ISIC Codes	Activity

[7] Satellite systems of national accounts are supplements to the core national accounts system. The idea of a satellite account was conceived in the System of National Accounts (SNA) in 1993 to expand the core national accounts for selected areas of interest, while using relevant concepts and structures from the core national accounts.

ISIC Codes	Activity
ICT manufacturing industries	
2610	Manufacture of electronic components and boards
2620	Manufacture of computers and peripheral equipment
2630	Manufacture of communication equipment
2640	Manufacture of consumer electronics
2680	Manufacture of magnetic and optical media
ICT trade industries	
4651	Wholesale of computers, computer peripheral equipment and software
4652	Wholesale of electronic and telecommunications equipment and parts
ICT services industries	
5820	Software publishing
Telecommunications	
6110	Wired telecommunications activities
6120	Wireless telecommunications activities
6130	Satellite telecommunications activities
6190	Other telecommunications activities
Computer programming, consultancy and related activities	
6201	Computer programming activities
6202	Computer consultancy and computer facilities management activities
6209	Other information technology and computer service activities
Data processing, hosting and related activities; web portals	
6311	Data processing, hosting and related activities
6312	Web portals
Repair of computers and communication equipment	
9511	Repair of computers and peripheral equipment
9512	Repair of communication equipment

Source: OECD document (2006); Sector definitions based on ISIC revision 4

Table 7 shows the link between the ICT activities and the GDP sector classification.

Table 7: Linking ICT activities to GDP sector classification

GDP sector classification	Code	ICT component
Manufacturing	2610	Manufacture of electronic components and boards
	2620	Manufacture of computers and peripheral equipment
	2630	Manufacture of communication equipment
	2640	Manufacture of consumer electronics
	2680	Manufacture of magnetic and optic media
Wholesale and retail trade; repair of vehicles	4651	Wholesale of computers, computer peripheral equipment and software
	4652	Wholesale of electronic and telecommunications equipment and parts
Information and Communication	5820	Software publishing
	60	Programming and broadcasting activities
	61	Telecommunications
	62	Computer programming, consultancy and related activities
	631	Data processing, hosting and related activities; web portal
Other service activities	951	Repair of computers and communication equipment

Source: OECD document (2006); Sector definitions based on ISIC revision 4

3.2 Identified economic activities/industries

The use of the OECD definition and classifications brought out the type of industries to be included in this study. However, this created some data collection difficulties. Given that the ICT sector is

dominated by formal activities which are covered by the VAT law, aggregated VAT data on output for the identified ICT activities had been used for these business entities.

For all ICT related establishments with the exception of the mobile telephony and tower companies, VAT output data for 653 companies across all ICT activities has been used for the estimation of Gross Value Added (GVA). 86 of these companies are involved in television and radio broadcasting[8] activities, 239 in computer consultancy and related service activities, and 328 in other telecommunication activities such as receiving telecommunications from satellite system; provision of Internet access over networks between the client and the ISP not owned — or controlled by the ISP, such as dial-up Internet access etc.; provision of telephone and Internet access in facilities open to the public — provision of telecommunications services over existing telecom connections: — VOIP (Voice Over Internet Protocol) provision etc.

Operations of telephony services were identified as the most organised in the ICT sector. Six mobile phone operators are currently in the industry namely; MTN, Vodafone, Airtel, Tigo, Glo and Expresso. Three companies provide tower services to support the mobile network operators. They include ATC Ghana (a subsidiary of American Tower Corporation), Helios Towers Africa and Eaton Towers.

3.3 Stakeholder consultation process

A number of stakeholders were engaged during the study in order to:

- Understand the operations of some specific activities
- Assess data availability
- Explain and align on key concepts and definitions

Key among them are the National Communications Authority (NCA), Ghana Statistical Service (GSS), Ghana Revenue Authority (GRA), the Association of Ghana Industries (AGI) and the Ghana Chamber of Telecommunications.

The team had continued interaction with the NCA because of its role as the regulator of the telecommunication and broadcasting industries. Correspondence with the GSS centred on bridging the international standard statistical codes from old to revised series (ISIC and HS), classification issues, and availability of data for compilation of GVA of the ICT sector. For external trade and revenue data, the team engaged the GRA as they play an important role in the generation of essential national data.

The team contacted the AGI for information on ICT establishments in the association, while the team's engagement with the Ghana Telecommunications Chamber was aimed at understanding how conducive the regulatory environment is for stakeholders of the telecommunication industry, the largest component of the ICT sector.

The team also engaged some software developers in an attempt to understand and capture a broader scope of ICT in Ghana.

Appendices A and B provides the list of stakeholders engaged and documents reviewed.

[8] Some of the companies have more than one registered broadcasting entity but maintains a single tax identification number for all of them.

3.4 Determining the contribution to the economy

Few countries have undertaken ICT satellite accounts, and the concepts and methods used in this study are largely based on existing international statistical standards for national accounts. This study focuses on the ICT sector activities and their contribution to the economy through their value added, contribution to GDP, capital formation, share of employment, foreign trade and revenue in the form of fees and taxes. The study applied the international standard classifications and methodologies in arriving at the different indicators and estimates.

3.4.1 Value added

The study used the output (production) approach, applying the standard value-added formula as follows:

Value added = **Output** *minus* **Intermediate consumption**

Output is the value of the goods and services which are produced by an establishment in the economy that become available for use outside that establishment. Intermediate consumption includes goods and services entirely used up by producers in the course of production of goods and services during the accounting period.

Both direct and indirect methods were used in arriving at value added. The direct method involved the extraction of information from financial statements of companies and survey data that has information on gross output and intermediate consumption. Identified gaps in the financial statements of some of the companies for some years were filled by using key output indicators to estimate the value added.

Table 8 is the template that was used for extracting the required information from the financial statements of the 6 mobile telecommunications service providers.

Table 8: Template used for extracting value added and operating surplus using the mobile telephone operators as example

Service Provider	Gross Output (GO)	Compensation of Employees	Consumption of Fixed Capital(CFC)	Taxes less Subsidies on Production	Intermediate Consumption (IC)	Gross Value Added (GVA)	Gross Operating Surplus(GOS)
	A	**B**	**C**	**D**	**E**	**F= A -E**	**G=F-B**
Airtel							
Vodafone							
Tigo							
MTN							
Glo							
Expresso							
Total							

Value added includes:

- Compensation of employees: Compensation of employees is the total remuneration in cash or in kind payable by employers to employees for services rendered. Direct social transfers from employers to their employees or retired employees and their families, such as health care benefits, educational grants and pensions that do not set up an independent fund, are also imputed to compensation of employees.
- Other taxes less subsidies on production: Other taxes less subsidies on production are taxes payable by employers to carry out production, irrespective of sales or profitability. They may be payable as license fees or as taxes on the ownership or use of land, buildings or other assets used in the production process or on the labour employed or on the compensation of employees paid. They are not taxes paid on value of sales or produced outputs, which are called taxes on products.
- Consumption of fixed capital: Consumption of fixed capital is the cost of fixed assets used up in production in the accounting period.
- Gross Operating Surplus (GOS)[9]: Gross operating surplus is the gross value added (which is gross output less the cost of intermediate goods and services) less compensation of employees.

Indirect methods were used for estimating value added under two circumstances. The first method used is the fixed input ratio method. This method was employed where output data was available but other relevant information was missing. Here benchmark ratios from the 2004 SUT[10] was used to estimate the value of products used as intermediate consumption and the value added. The study applied this estimation method on the VAT data which is composed of output and VAT payment due the company.

The second indirect method used is the commodity flow approach[11]. This method was employed where output data was not available or insufficient. This method provides a systematic and consistent framework for the estimation of GDP by final expenditures. Wholesale and retail of ICT goods are carried out together with other goods in many shops. Therefore, estimating the value added using the commodity flow method gives better estimates as compared to the direct method. Table 9 shows the valuation of total domestic supply using commodity flow approach.

Table 9: Commodity flow approach of estimating total supply

Components	Value
Domestic production	
plus imports (cost, insurance and freight, c.i.f)	
plus Transport cost	
plus Trade margin	
plus Product taxes	

[9] Definition of GOS is in line with the definition provided by the Eurostat Statistics.
[10] Benchmark ratios were used under the assumption that the indicator ratios had not changed.
[11] Vu Quang Viet (2011) 'Compiling GDP by final expenditure: An operational guide using commodity flow approach'

Equals Total Supply at purchasers' prices	

Output of trade services is the margin realized from a good purchased for resale. It is equal to sale less the cost to repurchase the good sold at the time it is sold. The trade margin ratio was derived from the 2004 SUT and adjusted by the ratio of intermediate consumption (also from 2004 SUT) to arrive at gross value added.

The imports and exports data formed the basis for the estimation of all taxes and duties paid during clearing of goods at the ports. Different taxes and rates are applied to the different types of goods imported. Since the commodity flow method used is a bottom-up approach, the detailed tax and levies used by Ghana Revenue Authority (GRA) was applied to arrive at the valuation stages in the System of National Accounts (SNA), which is for basic prices, producer prices and purchaser prices.

It was difficult to assign any ratio of the imports to capital formation as no study has been done to indicate the shares that go into final consumption and investment. No allowances were also made for inventory. The study attempted to adjust the import value for final consumption by deducting investment in network and tower equipment reported in the financial statements of the telecom and tower operators. However, it was noted that investments in such equipment for particular periods were larger than the imports producing negative values for imports. As it is not possible to have negative imports, the values were maintained for the estimation of value added for wholesale and retail trade.

3.4.2 Gross capital formation

Gross capital formation in the SNA is the same as the concept of investment in capital goods defined in economics. It includes produced capital goods (machinery, buildings, roads, artistic originals, etc.) and improvements to non-produced assets. Gross capital formation measures the addition to the capital stock of buildings, equipment and inventories, i.e., the addition to the capacity to produce more goods and income in the future.

Table 10 is the template used to extract gross capital formation. The data was sourced from the capital stock account or the "property, plant and equipment" section of the annual financial statements.

It was noted that the components of capital formation are presented differently in different financial statements depending the presentation style of the auditor. Therefore, reclassification and aggregation to correspond to the variables in the template had to be done.

Table 10: Capital formation template using the mobile phone companies as an example

Service Provider	Land and Buildings	Network Equipment	Furniture& Office Equipment	Motor Vehicles	Capital Work in Progress	Gross Fixed Capital Formation	Changes in Stocks/ Inventories	Gross Capital Formation
	A	**B**	**C**	**D**	**E**	**F = A+B+C+D+E**	**G**	**H= F+G**
Airtel								
Vodafone								
Tigo								
MTN								
Glo								
Expresso								
Total								

3.4.3 Foreign trade

This involved the selection of imported and exported ICT goods as captured by the Ghana Community Network (GCNet) and GRA database held at the GSS. The imports are in c.i.f. values while exports are in f.o.b. values. The study used the UNCTAD categorization of ICT goods (HS 2012). The number of goods identified in the database by groups is shown in Table 11. Consumer electronic equipment makes up a sizable proportion of the items in the database, followed by computers and peripheral equipment. The available data had only values and weights, but not quantities. This made it impossible to determine the number of the items imported into the country.

Table 11: Distribution of ICT goods by groups

ICT goods group (HS 2012)	No. of items
Computers and peripheral equipment	35
Communication equipment	10
Consumer electronic equipment	38
Electronic components	23
Miscellaneous	9
Total	**115**

3.4.4 Revenue (taxes and fees)

The ICT sector is multi-sectorial hence taxes and levies are not uniform for all players in the sector. Some activities are well organised thus making it relatively easier for the government to apply different types of taxes. In order to adequately capture taxes and fees from the ICT sector, the study designed a matrix of tax base and type of tax. Table 12 outlines the matrix of taxes and levies from the ICT sector.

From Table 12, it is only communication service tax (CST) and import duty that are not cross-sectorial. This therefore required the assistance of GRA personnel to disaggregate the tax data to allow the needed information to be extracted.

Table 12: Matrix of taxes and levies from the ICT sector

Tax base	Type of tax, levies and fees						
	Corporate/ Income	National Fiscal Stabilization Levy (NFSL)	Import duty	VAT	NHIL	Regulatory fees	Communication Service Tax (CST)
Telecommunication operators	X	X				X	X
Tower operators	X	X				X	
Broadcasting	X			X		X	
Manufacture of ICT goods	X			X			
Software developers	X						
Computer programming	X			X	X		
Wholesale and retail of ICT goods	X			X	X		
Foreign trade in ICT			X	X	X		

goods							

3.4.5 Employment

A stand-alone labour statistics study in the country was conducted decades ago. An attempt to conduct one in 1995 failed after the household listing exercise. Collection of employment statistics has been made an integral part of different socio-economic surveys like the Ghana Living Standard Surveys (GLSS) and Demographic and Health Surveys. The population and housing censuses have also produced statistics on employment. However, all these sources of employment statistics do not meet the requirements of this study since ICT is cross-sectorial.

The IBES conducted by the GSS with 2014 as the reference period, is the only source of data that is detailed enough (because it is an economic census) to provide the employment information needed for the study. The limitation of this data is that only figures for 2014 can be presented by the study, as it is not possible to undertake any interpolation without getting data for two end points.

3.4.6 Projection of the sector

The primary goal of forecasting is to create a credible sense of future happenings to inform policy and business planning.

In the process of forecasting, assumptions play a crucial role. Thus, forecasting requires a willingness to make certain assumptions which are considered to be the basic input for any forecast.

Generally, quantitative forecasting can be applied when two conditions are satisfied:

- Numerical information about the past is available
- Reasonable expectation that aspects of the past patterns will continue into the future

However, in the process of data compilation, the team observed that there were serious data gaps in some critical areas in the years before the study's starting point, 2010. This prevented the team from compiling a more exhaustive historical dataset for modelling forecasts.

This brings about rather serious implications for the generation of forecasts also emphasized by Hyndman and Kostenko's (2007)[12] conclusion that "the more data we have, the better we can identify the structure and patterns that are used for forecasting".

An alternative approach which typically works with fewer data points is the use of Extrapolating Regressions using the Ordinary Least Squares (OLS) method. However this forecasting technique is pivoted on the assumption that observed trends and cycles will continue. In view of the data point constraints, we cannot in our professional view make this assumption.

[12] Hyndman, R.J. & Kostenko, A.V. (2007, p.1). Minimum Sample Size Requirements for Seasonal Forecasting Models. FORESIGHT Issue 6, Spring 2007. Downloaded from www.bishophill.com/admin/sidebar_images/1741759940_test.pdf

While we could engineer a model to produce forecasts, given the inadequate data points, the accuracy of forecasts would be questionable. We must reiterate that the process of producing accurate, reliable forecasts depends on solid historical data reflecting appreciable trends.

Given that the study is a satellite account, the inclusion of relevant activities outside the scope of the traditional Information and Communication categorization, created a unique starting point of data collection resulting in difficulty reconciling past figures with current calculated figures.

An alternate approach which may have sufficed to circumvent the issue described above would be the use of GVA values to extrapolate the requested years.

While we were successful in estimating the annual GVA from 2010 to 2014, lack of disaggregated data made the estimation of monthly or quarterly data impossible[13]. This constraint stems from structural formats in the data collection and compilation systems of the GRA and the GSS.

As such we could generate only 5 data points which is severely inadequate for any robust forecasting. Given the availability of quarterly data for the period, it would have been adequate for accurate forecasts to be computed.

Forecasts were however generated for the telecommunication sub-sector, facilitated by the availability of adequate data points (monthly data). The variables of interest for the modelling were:

- voice subscription
- voice traffic
- data subscription
- data traffic
- LTE[14] subscription,
- LTE data traffic.

To be able to determine the appropriate estimation procedure to use, we first assessed the time series properties of the data by determining the order of integration of the series using unit root tests. The reason for this is that if the series are found to be non-stationary with the order of integration greater than or equal to 1, then ordinary least square (OLS) estimation approach and its traditional modifications can lead to spurious regression with inconsistent parameter estimates (Granger & Newbold, 1974). After performing Augmented Dickey-Fuller unit root tests for the variables, the results showed that voice subscription had unit roots as such is non-stationary. Voice subscription was therefore differenced to achieve stationarity.

Autoregressive process was used in modelling the time series of voice subscription, voice traffic, data subscription and data traffic. Autoregressive Moving Average (ARMA) was used for LTE subscription and LTE data traffic. ARMA assumes that the time series is stationary-fluctuates more or less uniformly around a time-invariant mean.

[13] Detailed explanations of disaggregation issues have been provided in the Data section of the report

[14] In telecommunication, Long-Term Evolution (LTE) is a standard for high-speed wireless *communication* for mobile phones and data terminals, based on the GSM/EDGE and UMTS/HSPA technologies.

The following are the structure of equations designed to model how the values of the variables in period t are related to past values:

$$\Delta VS_t = \alpha_0 + \alpha_1 \Delta VS_{t-1} + \alpha_2 \Delta VS_{t-2} + \varepsilon_1$$

$$VT_t = \delta_0 + \delta_1 VS + \delta_2 VT_{t-1} + \varepsilon_2$$

$$DS_t = b_0 + b_1 DS_{t-1} + b_2 DS_{t-2} + b_3 t + \varepsilon_3$$

$$DT_t = \beta_0 + \beta_1 DS + \beta_2 DT_{t-1} + \beta_3 t + \varepsilon_4$$

$$LTES_t = C_0 + C_1 LTES_{t-1} + C_2 \varepsilon_{5t-1} + C_3 t + \varepsilon_5$$

$$LTET_t = \psi_0 + \psi_1 LTES + \psi_2 LTET_{t-1} + \psi_3 \varepsilon_{6t-2} + \psi_4 t + \varepsilon_6$$

Where,

VS = Voice subscription
VT = Voice traffic
DS = Data subscription
DT = Data traffic
LTES = LTE subscription
LTET = LTE data traffic
t = time trend
α, δ, b, β, C and ψ are unknown coefficients that need to be estimated

The data source for the modelling was monthly data from January 2013 to December 2015 (36 data points) for voice subscription and traffic, and mobile data subscription and traffic. LTE data covered April 2015 to December 2016 (20 data points).

3.5 Data collection framework and instruments

To gain an overall impression of the contribution of ICT to the economy, different sources of information and data were considered. The types of data considered for the study included:

1. Documents on the subject area, both in hard and electronic form
2. Financial statements and annual reports of in-scope establishments
3. Published information (both private and public) e.g. fiscal data, output of national surveys
4. Administrative data e.g. unprocessed customs data from the GCNet system, VAT returns, call volumes from telecommunication companies etc.
5. VAT data from GRA
6. Surveys conducted by the team to fill gaps in points 2 and 3 above, using interview guides to capture all data needed for compiling value added and capital formation.[15]

The study adopted a data collection strategy which classified the different indicators of interest by their sources of data, as shown in Table 13.

Table 13: Matrix of indicators and their sources of data

Indicator	Sources of data				
	NCA	GSS	GRA	Sample	Other

[15] The interview guides used were developed based on templates provided in Tables 8 and 10.

				survey	
Investment in ICT equipment and software	X	X	X		
Consumption of ICT goods and services		X	X		X
Contribution of the ICT sector to employment growth	X	X			X
Size and growth of the ICT sector	X	X	X	X	X
Contribution of the ICT sector to international trade		X	X		
Tax revenue from ICT goods and services	X		X		

Adopting this framework helped in the data collection in two ways. Firstly, the team organized data collection and collation along common lines. In this way, data collection was efficient, and related to need. Secondly, working with this framework made it possible to identify not only existing information but also common gaps. These gaps were useful for developing the case for, and agreement about, the collection of new information.

3.6 Data collected and sources

As stated earlier, a satellite account is an extension of the System of National Accounts (SNA) that allows a component of the national framework to be examined with greater flexibility than the framework of the National Accounts[16] would typically allow. One key advantage of a satellite account lies in its' ability to isolate the ICT supply and demand sides in the various industries.
The major hurdle faced by the team from the onset was the absence of a reliable database from which sampling could be done to select establishments to visit. Financial statements were collected from identified establishments particularly the telephone network operators.

Templates were designed to collect information from the field, but the returns could not be used because of poor coverage. Output data from VAT therefore became one of the major sources of data. In all, the output data of 653 establishments which cut across the ICT sector, were used in most of the estimates. VAT systems have gained in prominence as a source of data for national accounts as more and more countries have implemented VAT over the past two decades[17]. These systems cover a broad range of goods and services that are sold by both producers and distributors, and they collect monthly and quarterly data as part of the tax collection process. Table 14 summarises information on data collected and their sources.

Table 14: Data collected and their sources

Type of information	Sources
Annual financial statements	NCA, and directly from computer and software programming companies
Telecommunication industry statistics	NCA
International trade data	GSS
Employment data	GSS, Financial statements
Supply and Use table, 2004	GSS
Input/output VAT data	GSS
Disaggregated tax data	GRA
Fiscal data	MoF

[16] National Accounts: The status of the Information and Communication Technology satellite account for South Africa.
[17] Update of "Quarterly National Accounts Manual: Concepts, Data Sources and Compilation"

Type of information	Sources
Data for modelling	NCA

3.7 Data quality assurance

The quality of the output of this study, like all statistical estimates, depends very much on the quality of the source data. In order to eliminate data entry errors, inputted data was cross-checked by other team members to assess accuracy and completeness. Estimation errors were also checked in the same manner.

As with most studies of this nature, we relied mostly on secondary data and undertook limited surveys where necessary to either complement the existing secondary data and/or obtain specific information required for the study. We did not seek to verify the accuracy or completeness of the existing data and information gathered through the limited surveys. We however made adjustments where necessary to ensure that the data was fit for purpose. In doing so, strict adherence to international standard adjustment procedures was applied to close data gaps.

3.8 Limitations of data

During the collection, compilation and processing of data for the study, a number of issues were identified which have implications for this report: These are:

1. The data available for the compilation of the main indicator, value added, is not sufficient for the compilation of some variables, especially, gross capital formation. As such, Gross Capital Formation (GCF) is best compiled from financial statements, and as indirect methods were applied in arriving at value added for some activities, it became impossible to apply indirect estimates in this situation. Additionally, there was no information on the proportion of ICT goods imports that feeds into final consumption and capital formation.
2. The financial statements submitted for this study did not have standardised presentation across firms, and sometimes, even over the referenced period of the same firm. This therefore required prudent scrutiny of each statement, with its accompanying notes, to arrive at rational conclusions for fairly accurate figures for estimations. For example, in some financial statements, there was no breakdown of the general and administrative expenses in some years within the referenced period. Hence expected deductions such as licenses & fees; bad debt; loss on disposal of assets; and unrealised exchange losses could not be easily deducted for calculations of Intermediate Consumption (IC). Challenges such as these were somewhat overcome by checking similar reports and notes of such companies provided for other years, for judicious calculations.
3. As follow-up to the previous point, not all the company's under consideration were able to provide financial statements for all the requisite years. Indeed, some did not provide their financial statements at all. For instance, 30 software publishers were initially targeted for inclusion in the study, but was discarded due to poor response rate to the team's request to participate in the study. Although relatively small, compared to their actual size in the economy, their participation could have provided some insights into that sub-sector of ICT, and improve the estimated size of the entire ICT's contributions to GDP as well as enrich the recommendations for policy enactments and/or implementation.

4. Similarly, the team was unable to obtain financial statements of broadcasters as they were not submitted since the policy of the regulator only requires the submission of the audited reports at the end of their fifth year when they are to renew their licence. The team therefore had to rely on VAT files to fill in the gaps; albeit with some limitations as outlined in the next point.
5. VAT data is presented on the basis of the legal entity, which may be engaged in various types of economic activity, rather than on the basis of type of activity. Therefore, the requisite level of detail may be lacking in the information collected. For example, most TV stations also operate radio broadcasting as well. However, VAT payments may be done based on the legal entity as a whole.
6. As has been the initial plan, the study could not use the IBES II for data on manufacturing and retail goods due to later than expected publication dates of IBES II. Future studies should thus be aligned with relevant publications such as this one.
7. Using benchmarked ratios of the 2004 SUT may not give estimates that reflect the current production mix. However, with a normal pace of economic development, using benchmark estimates within a 10-year interval may suffice**.**
8. Different versions of international standard classification codes made bridging of the codes a time-consuming exercise. For instance, the VAT data is classified in ISIC Revision 3.1 and had to be reclassified in ISIC Revision 4.
9. Request for disaggregated tax data from GRA did not elicit any response. This made it difficult to account for the total taxes and fees paid by businesses operating in the ICT sector. Contribution of ICT sector to domestic revenue is therefore likely to be understated in the report.
10. VAT data from GRA for 2015 was unusable for the study. This is because during the process of migrating data to TRIPS (GRA's tax application currently in use), provision was not made for ISIC codes for the establishments on the VAT register. This made it impossible for the study to estimate GVA for 2015 since VAT is a major source of data for many establishments in the ICT sector.

FINDINGS

4. Estimates of Contribution of ICT/Telecommunication Sector to the Economy

A satellite account as used in this study is to isolate the ICT supply and demand activities that cuts across the various industries. It defines which industries and products are ICT specific and related, and which industries and products are not. The advantage of using this approach is that ICT data included within the SNA framework are explicitly estimated. Estimates made in this study covers output, gross value added (GVA) and taxes paid by the ICT sector, the GDP contribution of the ICT sector, ICT employment, imports and exports of ICT products.

In Africa, it is only South Africa that is known to have compiled an ICT satellite account, with 2012 referenced as the most recent report. As such a comparison between the findings of this study will be made with the results of South Africa as presented in the "Information and Communications Technology satellite account for South Africa, 2012".

For this study the following were estimated; ICT GVA for the years 2010 to 2014, ICT sector employment for 2014[18] only, while all other estimates covered 2010 to 2015.

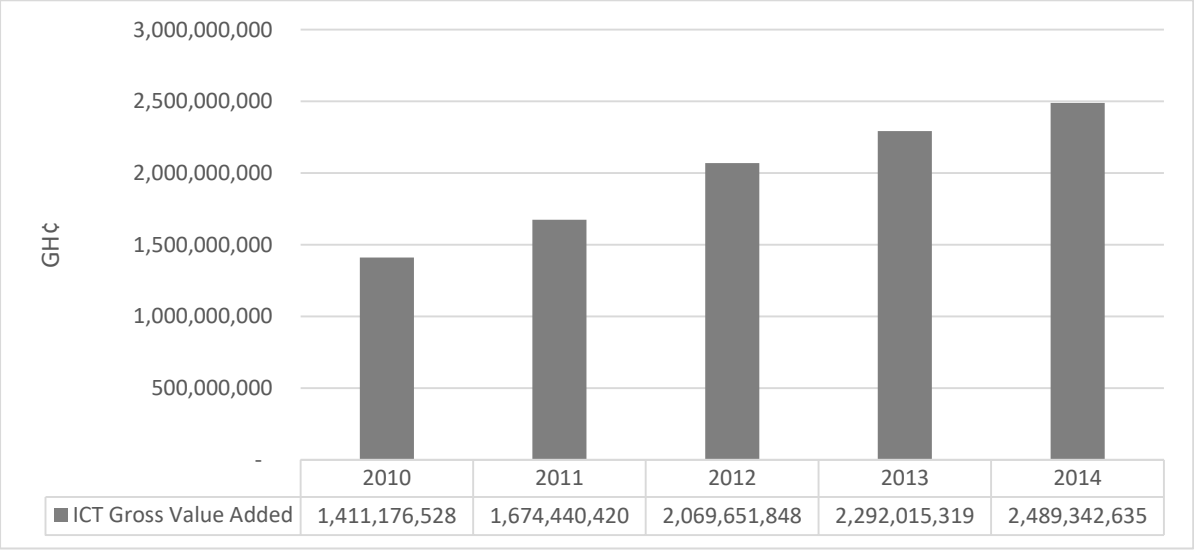
4.1 Contribution to GDP

There are multiple components of the ICT sector, and they are measured via the satellite account in this study. The direct contribution of the ICT sector to GDP is presented in this study in three ways: the GVA of the individual activities, the contribution to their related sectors, and the contribution to the total GDP.

4.1.1 Size of the ICT sector

The size of the ICT sector in terms of gross value added (GVA) increased from GH₵1.41 billion in 2010 to GH₵2.5 billion in 2014 (Figure 5). There has been consistent growth in the size of the sector over the reference period, with the largest annual change of 23.6% recorded in 2012.

Figure 5: Gross value added (GVA) of the ICT sector, 2010-2014



Source: EY's estimation

[18] The only complete dataset at the time was the IBES I which was undertaken by the GSS in 2014.

Table 15 shows the percentage share of the GVA of different activities in the ICT sector to total ICT GVA. The Telecommunication sector dominates the ICT sector. This is followed by ICT trade, with the remaining activities accounting for less than 4%. Comparing with South Africa, Telecommunications also dominates the ICT sector but with a lower share of 70.9% with computer services ranking second in terms of size with a share of 8.0%.

Table 15: GVA of the different activities in the ICT sector as a percentage share of total ICT GVA

Activity	2010	2011	2012	2013	2014
Manufacturing	2.8	2.0	0.8	1.3	0.9
Trade	11.5	11.9	11.6	9.9	11.6
Software publishing	0.1	0.2	0.2	0.2	0.1
Programming and broadcasting activities	0.4	0.4	0.6	0.8	1.0
Telecommunications	83.6	83.5	85.6	85.6	84.5
Computer programming, consultancy and related activities	1.3	1.1	1.0	1.7	1.6
Data processing, hosting and related activities; web portals	0.1	0.1	0.02	0.1	0.1
Repair of computers and communication equipment	0.2	0.8	0.3	0.4	0.2
Total ICT Gross Value Added	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: EY estimates

4.1.2 Share of ICT GVA in the Gross Domestic Product (GDP)

The most important variable in this study is the share of ICT GVA in the GDP. Though ICT GVA increased consistently over the reference period, the trend in its share of the GDP declined from 3.1% in 2010 to 2.2% in 2014 (Table 16). The ICT GVA figure for South Africa for 2012 was 2.9%, which is close to Ghana's ICT GVA of 2.8%.

Table 16: ICT sector analysis and contribution of ICT GVA to GDP ***(GH¢ million)***

Activity	2010	2011	2012	2013	2014
Manufacturing	**2,941.5**	**3,842.5**	**4,263.3**	**4,800.4**	**5,341.8**
ICT Manufacturing	31.6	27.5	12.0	22.4	18.8
Share of ICT (%)	*1.1*	*0.7*	*0.3*	*0.5*	*0.4*
Wholesale and retail trade; repair of motor vehicles and motorcycles	**2,701.0**	**3,282.3**	**4,059.9**	**5,221.9**	**6,084.9**
ICT Trade	139.6	171.6	182.7	164.9	237.9
Share of ICT (%)	*5.2*	*5.2*	*4.5*	*3.2*	*3.9*
Information and Communication	**831.1**	**988.9**	**1,590.2**	**1,571.5**	**2,441.0**
ICT Information and Communication	1,237.1	1,463.6	1,870.6	2,098.6	2,229.4
Share of ICT (%)	*148.9*	*148.0*	*117.6*	*133.5*	*91.3*
Other service activities	**1,721.5**	**2,158.7**	**2,701.2**	**3,886.5**	**4,445.5**
Repair of computers and communication equipment	2.8	11.7	4.3	6.1	3.3
Share of ICT (%)	*0.2*	*0.5*	*0.2*	*0.2*	*0.1*
GDP (National)	**46,042.1**	**59,816.3**	**75,315.4**	**93,415.9**	**113,343.4**
Total ICT GVA	**1,411.2**	**1,674.4**	**2,069.7**	**2,292.0**	**2,489.3**

Activity	2010	2011	2012	2013	2014
Share of ICT (%)	***3.1***	***2.8***	***2.8***	***2.5***	***2.2***

Source: EY estimates and GDP figures as published by the GSS

As per Table 16, the share of ICT in Information and Communication clearly shows underestimation of the sector in the published GDP. This is supported by the fact that, the ICT GVA component alone is larger than the related sector's share of GDP.

4.2 Contribution to capital formation

The term capital formation or investment refers to the expenditure associated with acquiring the ownership of property (including intellectual and non-tangible property such as computer software) and plant. This includes expenditure on initial installations and additions to existing installations where the usage is expected to cover an extended period of time. The best source of information on capital formation on an activity or sector basis is through the financial statements of companies involved. While this information is difficult to come by in developing countries, primarily due to their large informal sectors, the commodity flow approach is suitable and often used in arriving at national estimates.

Total capital formation for the ICT sector could not be computed during the study because of its cross-sectoral nature and the different methods used in estimating the main indicator, GDP. Where GDP estimates were computed from financial statements, capital formation values were compiled.

Table 17 outlines capital formation in the telecommunication industry. The information presented is on the six mobile network operators and the three tower operators. Within the reference period, capital formation in nominal terms, was highest in 2010 (GH₵1.75 billion). There were large expenditures on installations of network and tower equipment and also large expenditures on capital work in progress for that year. MTN Ghana and Vodafone Ghana's investment spending led to the large investment growth in 2010. The subsequent two years recorded declining investments, before increasing afterwards. Business cycle phases dictate the level of investment made as such reduction in capital expenditures do not necessarily imply declining growth prospects in the industry.

Table 17: Capital formation of the telecommunication industry

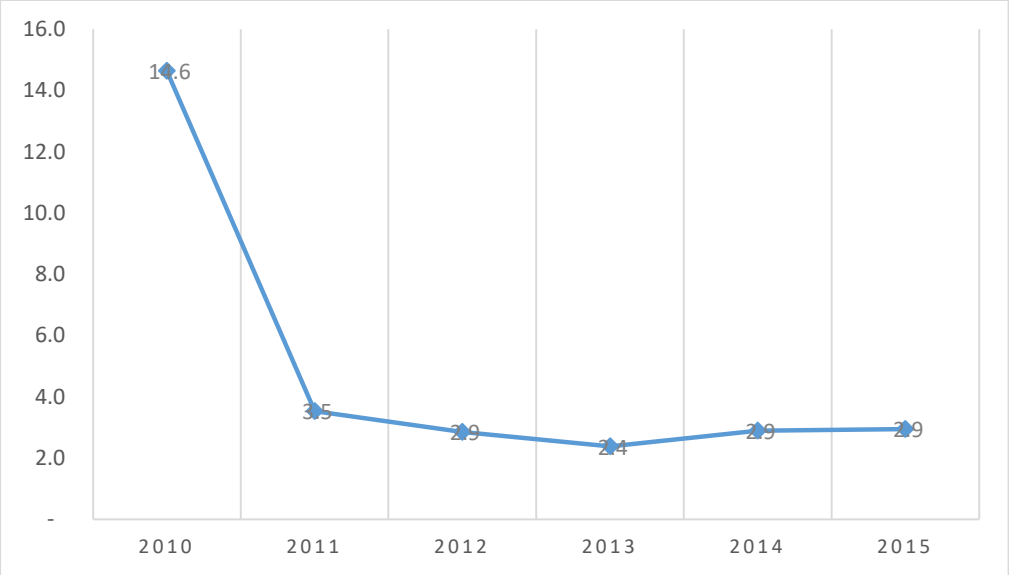
Year	Land improvement & Buildings	Network & tower equipment	Furniture & office equipment	Motor vehicles	Capital work in progress	Gross fixed capital formation	Changes in stock	Gross capital formation
2010	28,835.00	895,532.00	53,611.00	22,081.00	713,613.00	**1,713,672.00**	39,266.00	**1,752,938.00**
2011	25,587.00	164,214.95	20,125.41	3,316.22	298,447.70	**511,691.28**	46,837.20	**558,528.48**
2012	4,068.76	299,492.85	37,515.31	3,035.72	239,799.22	**583,911.85**	98,942.53	**682,854.38**
2013	5,776.00	259,947.08	24,002.98	729.27	289,476.50	**579,156.82**	38,787.88	**617,944.70**
2014	1,722.00	193,151.27	16,066.74	6,718.00	610,389.90	**828,047.91**	62,766.28	**890,814.19**
2015	63,627.00	339,784.38	95,692.04	5,195.57	448,812.61	**953,111.61**	52,513.82	**1,005,625.42**

Source: EY estimates

Investment in the telecom industry as a share of total investment plummeted from 14.6% in 2010 to 3.5% in 2011 (Figure 6). There were further declines thereafter, however there was increase in 2014 and 2015. As stated earlier, the comparatively larger share in 2010 was on account of large investments in telecom and tower equipment with equally large capital work in progress.
The reasons for the relatively lower shares recorded after 2010 are two-fold:

- Decreasing investments in the sector
- Increasing investment in other sectors of the economy as shown in the expenditure side of the GDP. In comparison, the share of ICT gross capital formation to the total was 4.7% for South Africa in 2012.

Figure 6: Investment in the telecom industry as a share of total investment



Source: EY estimates

4.3 Contribution to foreign trade

ICT goods are divided into five broad categories as follows:

1. Computers and peripheral equipment
2. Communication equipment
3. Consumer electronic equipment
4. Electronic components
5. Miscellaneous

The continuous increase in the global trade of ICT goods is being driven by the mobile telephone revolution in developing countries, with China as the world's top trader in all categories of the sector. No African country is among the top 20 importers and exporters of ICT goods, according to UNCTAD.

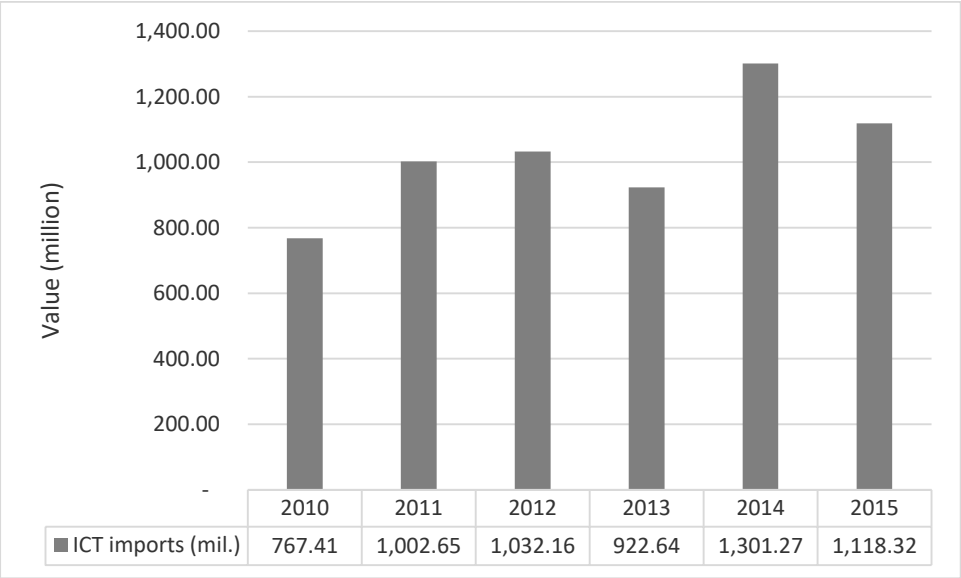
There is no clear trend in the value of ICT goods imports over the years. The value of ICT goods imports increased by 30.7% in 2011 over that of 2010, with a marginal growth in 2012 (2.9%), before declining by 10.6% in 2013. There was a 41% increase in 2014, but declined by 14.1% in 2015. The value of imports of ICT goods is shown in Figure 7.

Communication equipment dominated the value of imports of ICT goods in Ghana over the reference period, constituting over 50% of all ICT goods imported between 2010 and 2012, as shown in Table

18. Computers and peripheral equipment constituted the second largest ICT goods imports category, followed by consumer electronic equipment such as television and radio sets.

The share of the ICT goods imports in total imports has been declining consistently from 6.2% in 2010 to 2.4% in 2015. Compared with South Africa, ICT goods made up 10.4% of the country's imports in 2012.

Figure 7: Value of ICT goods imports, 2010-2015



Source: EY estimates

Table 18: Percentage distribution of imports of ICT goods by categories

Categories	2010	2011	2012	2013	2014	2015
Computers and peripheral equipment	23.1	16.8	24.6	27.3	22.7	21.5
Communication equipment	60.8	62.9	52.5	44.2	47.7	44.9
Consumer electronic equipment	9.2	11.0	13.7	20.1	14.1	20.7
Electronic components	5.0	8.0	7.8	6.8	10.1	8.1
Miscellaneous	1.9	1.3	1.3	1.6	5.5	4.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
ICT Imports/Total Imports	**6.2**	**5.3**	**4.2**	**3.7**	**3.3**	**2.4**

Source: EY estimation from Customs database

Table 19 shows the share of the different categories of ICT goods in total ICT exports. Unlike imports which are dominated by communication equipment, the dominance of exports is shared between computers and peripheral equipment and communication equipment.

Table 19: Percentage distribution of exports of ICT goods by categories

Categories	2010	2011	2012	2013	2014	2015
Computers and peripheral equipment	51.6	17.6	18.2	39.8	34.5	61.6
Communication equipment	19.7	37.5	45.9	52.9	30.4	16.0
Consumer electronic equipment	2.6	14.4	6.4	4.7	8.4	2.7
Electronic components	23.0	28.2	28.4	2.3	25.9	18.2
Miscellaneous	3.2	2.3	1.0	0.3	0.8	1.5

Categories	2010	2011	2012	2013	2014	2015
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
ICT Exports/Total Exports	**0.01**	**0.06**	**0.06**	**0.18**	**0.05**	**0.07**

Source: EY estimates from Customs database.

Exports of ICT goods as a share of total merchandise exports was very low, with the highest share of 0.18% recorded in 2013. This picture is not akin to Ghana only, as the UNCTAD reports that ICT goods from Africa account for less than 1% of the continent's total merchandise exports, as few African countries have developed an ICT goods manufacturing industry. However, South Africa exports more than the African average, as exports of ICT goods constituted 2.8% in 2012.

Appendix D provides the details of the value of imports and exports of ICT goods from 2010 to 2015.

4.4 Contribution to national revenue

Table 20 shows estimated ICT taxes and fees. It should be noted that the ICT sector could not be covered fully with respect to company taxes, NFSL and regulatory fees. Therefore, the estimates of the share of ICT taxes and fees to total domestic revenue is an indicative figure, the largest activity in the ICT sector is mobile telecommunications whose coverage was relatively more complete.

Table 20: Contribution of the ICT sector to domestic revenue

Tax type	2010	2011	2012	2013	2014	2015
Corporate tax**	86,628,000	234,240,024	215,630,022	85,285,203	165,831,668	195,633,000
NFSL**	18,866,000	36,952,000	-	11,597,000	25,441,260	31,433,000
CST	137,339,390	135,044,350	128,376,330	173,978,929	216,600,504	251,848,416
Import duty	56,289,438	81,999,915	82,372,602	84,017,930	130,150,258	118,688,907
Import VAT	102,569,605	134,382,308	137,320,325	129,298,022	208,263,125	179,940,507
Import NHIL	17,094,934	22,397,051	22,886,721	21,549,670	34,710,521	29,990,085
Regulatory fees**	30,175,290	43,910,433	46,013,691	55,561,319	86,783,061	57,795,000
Total ICT	448,962,657	688,926,082	632,599,692	561,288,073	867,780,397	865,328,915
Total domestic revenue++	7,656,667,444	9,281,941,314	15,508,092,503	18,732,110,276	23,931,320,000	29,351,650,000
Share of ICT (%)	***5.9***	***7.4***	***4.1***	***3.0***	***3.6***	***2.9***

**Covered only the mobile telephony and tower activities. The NFSL was introduced for 2009 to 2011, and was reintroduced in 2013. That is why there is no value for 2012
++Excludes grants
Source: From government's fiscal data and financial statements of the telecommunication companies

The ICT sector in 2010 contributed an estimated amount of GH¢449 million to domestic revenue, and this figure increased to GH¢865.3 million in 2015 (Table 20). In terms of percentage shares, the largest (7.4%) was recorded in 2011, while the lowest (2.9%) was recorded in 2015.

The ICT sector is generally taxed more than the other sectors of the economy as the contribution to domestic revenue is relatively higher as compared to the contribution of the ICT to GDP.

4.5 Contribution to employment

The economic impact of ICT extends to job creation. It creates self-employment opportunities resulting from the availability of communication networks and employment in manufacturing and installation of telecommunications equipment.

All information on employment in this section of the study is from the IBES I with reference to 2014. The first phase of the IBES was a census and covered all non-household establishments. The total number of employed persons across all sectors of the economy, according to the census, was 3,383,204. Out of this number, only 40,635, constituting 1.2%, were employed in the ICT sector (including broadcasting).

The telecommunication industry engaged 36.9% of the total workforce of the ICT sector (Table 21). The second largest industry in terms of employment was broadcasting (radio and television) with a share of 22% of the ICT sector's total employment. The Software publishing industry employed the least number of people in the sector.

Table 21: Number of people employed in the ICT sector by type of activity, 2014

Description of activity	Male	Female	Total
Manufacturing	1,362	549	1,911
Wholesale and retail trade	1,823	851	2,674
Software publishing	221	71	292
Telecommunications	10,618	4,382	15,000
Computer programming, consultancy and related activities	3,618	1,222	4,840
Data processing, hosting and related activities; web portals	351	106	457
Repair of computers and communication equipment	5,662	820	6,482
Radio broadcasting	4,568	1,390	5,958
Television programming and broadcasting	2,122	899	3,021
Total	**30,345**	**10,290**	**40,635**

Source: IBES phase 1

5. Detailed Analysis of the Telecommunications Sub-Sector

The telecommunications sub-sector as defined by the ISIC rev. 4 covers "the activities of providing telecommunications and related service activities, i.e. transmitting voice, data, text, sound and video. The transmission facilities that carry out these activities may be based on a single technology or a combination of technologies. The commonality of activities classified in this sub-sector lies in the transmission of content, without being involved in its creation. The breakdown in this sub-sector is based on the type of infrastructure operated" (ISIC rev 4).

The sub-sector has four classes, namely;

- Wired telecommunications activities
- Wireless telecommunications activities
- Satellite telecommunications activities
- Other telecommunications activities

It can be observed from the analysis that the telecommunication sub-sector is the largest within the ICT sector. Investment in the telecommunications sector has completely transformed communication activities through the use of cellular phones and other mobile devices. The introduction of mobile money services as an innovation for money transfer and its use for transactions has further increased the urge to own cellular phones in rural areas.

The companies identified for this study in the telecommunication industry include 2 fixed telephone companies and 6 mobile telephony operators popularly known as the Telcos, 3 tower operators and 328 establishments engaged in other telecommunication activities such as the provision of telephone and Internet access in facilities open to the public — provision of telecommunications services over existing telecom connections (popularly known as internet cafes) and others.

5.1 Disaggregation of Gross Value Added (GVA)

The study was able to disaggregate the GVA for the telecommunication industry into three categories as shown in Table 22. The disaggregation was made based on the type of data available for the estimation of GVA. Financial statements were used for the wired and wireless telecommunications operations (Telcos) and the tower operations, while VAT output data was used for the other telecommunication service category.

Table 22: Disaggregation of GVA of telecommunication ***(Thousand GH¢)***

Activity	2010	2011	2012	2013	2014
Wired and wireless telecom (Telcos)	949,149	1,123,572	1,175,381	1,400,285	1,693,750
Towers	2,361	42,664	164,038	28,872	17,654
Other telecommunication	264,346	272,575	504,048	622,656	462,050
Total telecommunication GVA	**1,215,857**	**1,438,811**	**1,843,467**	**2,051,813**	**2,173,454**
Total GDP	**46,042,100**	**59,816,300**	**75,315,400**	**93,415,900**	**113,343,400**
Share of telecommunication GVA in Total GDP (%)	**2.6**	**2.4**	**2.4**	**2.2**	**1.9**

Source: EY estimates

The GVA of the industry increased continuously from 2010 to 2014 (as shown in Table 22). However, its share of GDP depicted a different picture. The industry contributed 2.6% to GDP in 2010, but declined subsequently to 1.9% in 2014. The GVA of the Telcos increased consistently over the period, but GVA for the tower companies increased from 2010, peaked in 2012 and declined in subsequent periods.

The GVA of the other telecommunication services also increased from 2010 to 2013 before dipping in 2014. The Telcos alone contributed 2.1% to GDP in 2010 and 1.5% in 2014.

Components of the GVA for the Telcos are shown in Table 23. Gross output increased annually from GH¢ 2.02 billion in 2010 to more than double in 2015. There were continuous increases in both consumption of fixed capital and intermediate consumption as output increased. Taxes did not exhibit the same trend as the other variables presumably due to deferred taxes in certain years.

Table 23: Components of GVA of mobile telecommunication industry **(Thousand GH¢)**

Year	Gross output (GO)	Compensation of employees	Consumption of fixed capital (CFC)	Taxes on production	Intermediate consumption (IC)	Gross Value Added (GVA)	Gross operating surplus (GOS)
2010	2,032,856.74	232,177.01	394,806.05	86,628.00	1,081,346.39	**951,510.36**	719,333.35
2011	2,438,479.07	212,424.10	474,572.27	234,240.02	1,272,242.86	**1,166,236.21**	947,082.52
2012	3,148,730.98	358,692.03	553,427.51	215,630.02	1,271,224.15	**1,339,418.83**	980,726.80
2013	3,579,240.82	231,777.12	537,226.11	85,285.20	2,150,083.78	**1,429,157.04**	1,197,379.92
2014	4,151,118.24	269,873.88	603,406.65	165,831.67	2,439,714.12	**1,711,404.12**	1,441,530.24
2015	4,292,232.53	273,099.00	594,324.00	195,633.00	2,168,869.00	**2,121,169.00**	1,848,070.00

Source: EY estimates

5.2 Contribution to domestic revenue

The Telcos contributed 3.6% to total domestic revenue (excluding grants) in 2010. This increased to 4.8% in 2011, but recorded declines in subsequent years reaching a low of 1.7% in 2013. Its contribution to domestic revenue increased in 2014 but declined in 2015 (Table 24).

Table 24: Estimated taxes and fees contributed by the Telcos

Tax type	2010	2011	2012	2013	2014	2015
Corporate tax	86,628,000	234,240,024	215,630,022	85,285,203	165,831,668	195,633,000
NFSL	18,866,000	36,952,000	-[19]	11,597,000	25,441,260	31,433,000
CST	137,339,390	135,044,350	128,376,330	173,978,929	216,600,504	251,848,416
Regulatory fees	30,175,290	43,910,433	46,013,691	55,561,319	86,783,061	57,795,000
Total taxes paid by Telcos	273,008,680	450,146,807	390,020,043	326,422,451	494,656,493	536,709,416
Total domestic revenue++	7,656,667,444	9,281,941,314	15,508,092,503	18,732,110,276	23,931,320,000	29,351,650,000
Share of Telcos (%)	***3.6***	***4.8***	***2.5***	***1.7***	***2.1***	***1.8***

++ Excluding grants
Source: EY estimates

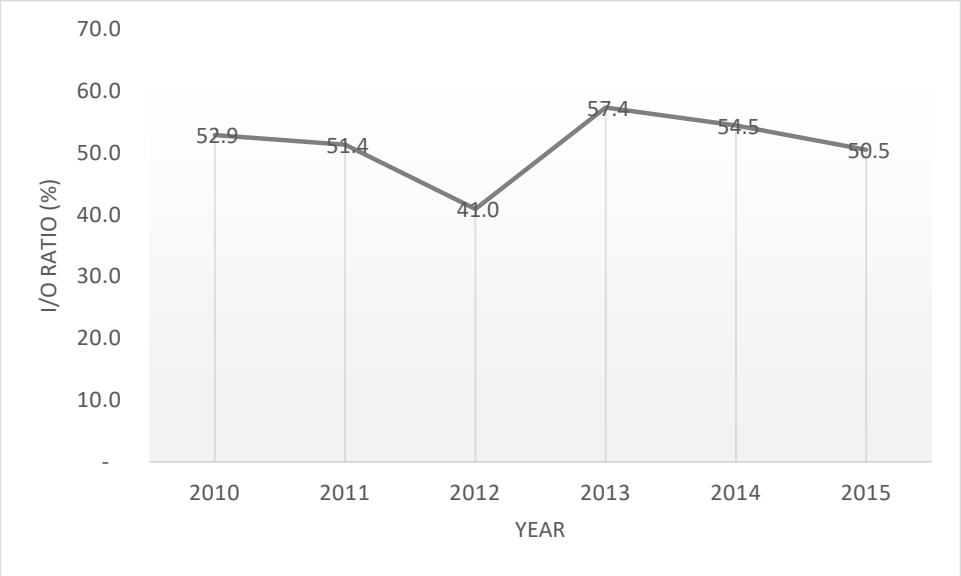
5.3 Some productivity indicators in the Telcos

Value added is defined as the value of gross output minus intermediate consumption (the cost of raw materials, energy and other intermediate inputs). Material efficiency is often defined as the provision of more goods and services with fewer materials. Therefore, the declining ratio of intermediate consumption (IC) to gross output (GO) is a sign of material efficiency in production. This has implications on the pricing of goods and services produced.

Figure 8 provides a trend in IC/GO ratios from 2010 to 2015. There was a slight decline in the ratio between 2010 and 2011, with a significant dip in 2012. 2013 saw a significant rise in the ratio, as on average, the Telcos had to increase their IC/GO ratio from 41% in 2012 to 57.4% in order to produce the 2013 output. However, the ratio declined afterwards.

[19] The NFSL was a government policy which was suspended in 2011 and resumed in 2013.

Figure 8: Intermediate consumption/gross output ratio



Source: EY estimates

The next indicator of interest is labour productivity. Labour productivity can be measured as the ratio of total output (goods or services) to the number of workers used to produce the output.

Table 25: Trend in labour productivity in the Telcos

Year	No. of employees	Gross output (GH¢)	Output per worker (GH¢)	Productivity Growth (%)	GFCF (GH¢)	Growth in GFCF (%)
2012	3,944	2,902,648,000	735,965.52	-	530,324,263	-
2013	4,145	3,287,210,000	793,054.28	7.8	594,672,909	12.1
2014	3,822	3,721,666,000	973,748.30	22.8	814,586,608	37.0
2015	3,905	4,292,232,533	1,099,163.26	12.9	914,245,000	12.2

Source: Financial statements of Telcos and EY estimates

Labour productivity has been increasing annually (shown in Table 25). Though the total number of employees reduced in 2014, labour productivity growth was at its peak the same year. Growth in labour productivity is directly attributable to fluctuations in physical capital, new technology and human capital. If labour productivity is growing, it can be traced back to growth in one of these three areas. Growth in GCF (physical capital) supports this assertion. There was an annual increase of 12.1% in physical capital, a higher increase of 37% in 2014 (the period that total employment reduced), and 12.2% in 2015.

5.4 Forecasts for the telecommunication sector

There is evidence of fast growing demand for telecommunication services in the country. From a low subscription of 90,000 in 2000, the number of subscribers increased to 37.3 million in October 2016. Data usage is also increasing at a fast pace because of its use in business and growing reliance on mobile phones due to advancement in handset technology expanding the possible range of uses.
It is therefore not surprising that mobile handset acquisition, data subscription and data usage are increasing very fast. Projecting the demand for telecommunication services in the future is, therefore, an important requirement for stakeholders in the industry.

Forecasting is conducted for many purposes.

This study considered forecasting for the following reasons:

- Planning and budgeting: Network planners can use forecast data to decide how much equipment to purchase and where to place it to ensure optimum management of traffic loads. For the regulator, it can help in knowing the expected revenues for planning and budgeting for regulatory activities. It can also help the regulator to know the extent of interventions needed to improve the use of telecommunication services. For example, the NCA should be able to know whether the approved wireless spectrum — the slice of frequencies over which data, calls, and texts are transmitted — are adequate in the years ahead.
- Evaluation: Forecasting can help management make informed decisions on what will be to the advantage or detriment of the company.
- Verification: As new forecast data becomes available it is necessary to check whether new forecasts confirm the outcomes predicted by the old forecasts.

It should be noted that forecasting models used base their estimations on historical trends, and there are a number of shocks that can influence the future path which the model cannot predict.

5.4.1 Voice subscription and traffic

Voice service is the oldest among the services provided by telecommunication service providers. Voice subscription is forecasted to increase from 35.0 million subscribers at the end of December 2015 to 52.5 million in December 2020 (Table 26). Annual growth rate in subscriber base is expected to decline over the forecast period as shown in Table 26. Penetration rate, however, is projected to increase over the forecast period, increasing from 126.5% in December 2015 to 169.6% in December 2020.

Table 26: Forecasts of voice subscriptions and voice traffic for 2017 to 2020

	Actual	Forecast				
Variable	2015	2016	2017	2018	2019	2020
Subscription**	35,008,387	38,709,340	42,154,700	45,600,050	49,045,400	52,490,760
Growth (%)	....	*10.6*	*8.9*	*8.2*	*7.6*	*7.0*
Voice traffic (bil. min)	43,518,934	51,602,976	57,218,466	63,330,087	69,937,837	77,041,720
Growth (%)	....	*18.6*	*10.9*	*10.7*	*10.4*	*10.2*
Penetration rate (%)	126.5	136.8	145.5	154.0	162.0	169.6

*** End December figures*
Source: EY estimates

Domestic voice traffic may be defined as total on-net and total off-net traffic with the off-net traffic comprising outgoing off-net to mobile and outgoing off-net to fixed networks. Voice traffic is projected to grow from 43,518,934 billion minutes in 2015 to 77,041,720 billion minutes in 2020. Decline in the rate of increase of voice traffic is expected, but at a slower rate than that of the subscriber base.

5.4.2 Data subscription and traffic

Mobile data is one way that mobile device users gain wireless access to the internet. Digital communication (via mobile data) began in the early 1990s with electronic mails (e-mails) before it evolved into more complex forms such as web browsing, downloading, social media, watching TV programmes, watching videos on YouTube, streaming music, etc.

Subscriber base for mobile data is projected to grow at an annual rate of 16.2% from 2016 to 2020, settling at a forecasted subscriber base of 38,318,990 in December 2020 (shown in Table 22). Penetration rate is projected to increase from 92% in 2017 to 123.8% in 2020.

Forecast figures for data traffic in 2020 is more than double that of 2017. The fast growth in data usage will result in rapid increase in traffic per capita over the forecast period. Traffic per capita is projected to double between 2017 and 2020 (shown in Table 27).

Table 27: Data subscription and traffic

Variable	Actual	Forecast				
	2015	2016	2017	2018	2019	2020
Subscription**	18,106,280	22,758,670	26,648,750	30,538,830	34,428,910	38,318,990
Growth (%)	-	*25.7*	*17.1*	*14.6*	*12.7*	*11.3*
Data traffic(Gb)	33,565,932	61,859,809	91,883,269	124,801,165	159,647,610	195,779,020
Growth (%)	-	*84.3*	*48.5*	*35.8*	*27.9*	*22.6*
Traffic per capita (Mb)	1,853.8	2,718.1	3,447.9	4,086.6	4,637.0	5,109.2
Penetration rate (%)	65.4	80.4	92.0	103.1	113.7	123.8

*** End December*
Source: EY estimates

5.4.3 Long Term Evolution (LTE) subscription and LTE data usage

The emergence of LTE, a new generation mobile network technology, is revolutionizing the use of data services. Demand is growing rapidly for broadband-enabled data applications in energy production (including oil and gas), defence, remote data acquisition, video surveillance and others. All the major mobile infrastructure vendors consider LTE the strategic technology of choice for future mobile broadband communications and therefore are actively targeting this business opportunity[20].

The technical complexity of the new technology makes LTE devices more expensive than the 3G devices because of the increased memory and processor requirements needed to process the volume of data enabled by LTE. The higher cost of LTE devices will slow down growth in subscription to a point where prices of the devices will reduce.

Table 28 shows the forecasts from 2017 to 2020 for subscription, data usage and penetration.

Table 28: Forecasts for LTE subscription and data traffic

Variable	Actual	Forecast			
	2016	2017	2018	2019	2020
Subscription	109,729	123,576	136,828	150,080	163,332
Growth (%)	-	*12.6*	*10.7*	*9.7*	*8.8*
Data traffic (Gb)	11,165,831	15,017,574	18,683,682	22,349,778	26,015,883
Growth (%)	-	*34.5*	*24.4*	*19.6*	*16.4*
Traffic per capita (Gb)	101.8	121.5	136.5	148.9	159.3
Penetration rate (%)	0.4	0.4	0.5	0.5	0.5

Source: EY estimates

[20] From an article by Stephen Hartley and Julien Grivolas, titled "LTE: The Future of Mobile Data" posted on http://forbescustom.com/TelecomPgs/LTEP1.html

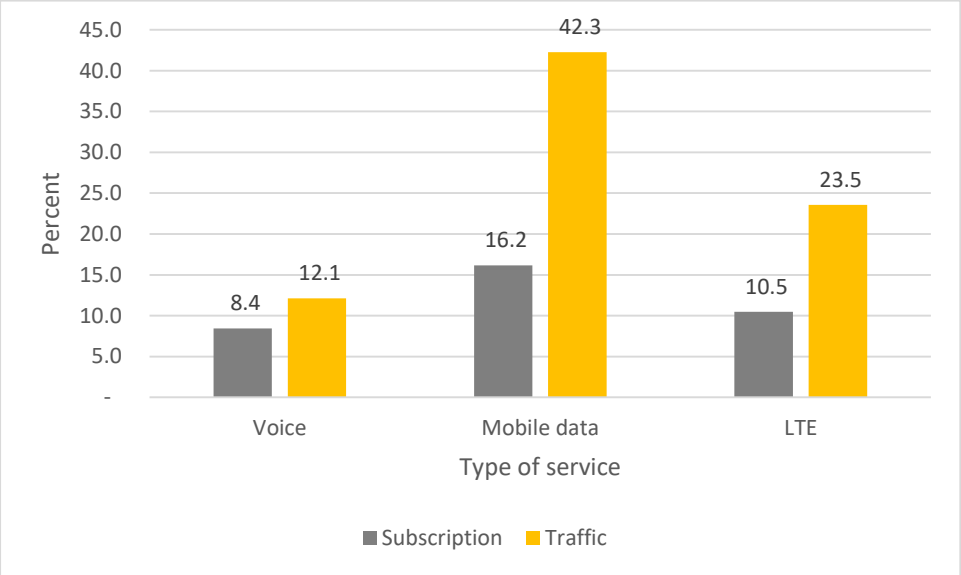
LTE subscription is projected to increase from 109,729 at the end of 2016 to 163,332 subscribers at the end of 2020 (Table 28). Though the forecasts show increase over the period, as with the other subscriptions (voice and mobile data), the growth rate is expected to decline over time. Penetration rate is projected to increase marginally from 0.4% in 2016 and 2017 to 0.5% for the remaining forecast periods.

LTE data traffic is projected to double by 2019 from the 2016 level, with a further increase of 16.4% in 2020 from the 2019 level. Per capita data traffic is projected to grow at an annual average of 11.9% from 2016 to 2020.

5.5 Comparing projected growth in telecommunication services

Figure 9 compares the projected annual average growths of the three different telecommunication services over the forecast period. Mobile data is projected to grow faster than the other service types in both subscription and data traffic. Growth in LTE subscription and data traffic is next, with voice subscription and traffic growing below 10%.

Figure 9: Projected annual average growth of different types of services in the Telecommunication sub-sector from 2015 to 2020



Source: EY estimates

SECTION 4: CONCLUSIONS

6. Conclusions and Lessons Learnt

This study is basically a supply-side ICT sector satellite account, despite it being titled "Determination of the contribution of the ICT/Telecommunication sector to the GDP of Ghana". There are few examples of ICT satellite accounts internationally, and the concepts and methods used in this study are based on existing international statistical standards for concepts, methods and definitions for national accounts.

6.1 General conclusion

This report estimates the magnitude of ICT contributions to GDP, capital formation, foreign trade (imports and exports), employment and domestic revenue. The study period is 2010 to 2014 inclusive. The study also gives emphasis to the telecommunication industry, which is the largest in the ICT sector, with further analyses including projections of its growth from 2015 to 2020.

Table 29 summarises the findings of the study. ICT sector's contribution to the economy over the study period was highest in 2010, except domestic revenue where 2011 was the highest. The ICT sector's contribution to GDP was 3.1% in 2010 and declined continuously to 2.2% in 2014. Since ICT GVA increased consistently over the period, the decline in share of GDP can be attributed to two things:

- Other sectors of the economy growing faster than the ICT sector
- Inflation in the ICT sector lower than the other sectors as shares are computed in nominal terms.

Table 29: Summary of indicators

ICT contribution as % of:	2010	2011	2012	2013	2014	2015
GDP						
Overall	3.1	2.8	2.8	2.5	2.2	-
Manufacturing	1.1	0.7	0.3	0.5	0.4	-
Trade	5.2	5.2	4.5	3.2	3.9	-
Information and communication	148.9	148.0	117.6	133.5	91.3	-
Other service activities	0.2	0.5	0.2	0.2	0.1	-
Imports	6.2	5.3	4.2	3.7	3.3	2.4
Exports	0.01	0.06	0.06	0.18	0.05	0.07
Gross Capital formation	14.6	3.4	2.4	2.2	2.7	2.8
Employment	-	-	-	-	1.2	-
Domestic revenue	5.9	7.4	4.1	3.0	3.6	2.9

Source: EY estimates

By sectoral contributions, ICT contributes more to the Information and Communication sector than the other components. Wholesale and retail trade in ICT goods is comparatively better than the remaining components.

With low level of manufacturing of ICT goods, imports constitute the largest portion of total domestic supply. The low level of manufacturing is also reflected in ICT exports which are insignificant among total exported goods. The share of imported ICT goods to total imports declined from 6.2% to 2.4%.

The study indicates that communication equipment constitutes the largest share of imported ICT goods. Conversely, computers and peripheral equipment, communication equipment,

and consumer electronic equipment contributes to export in Ghana. ICT exports as a percentage of total merchandised exported however remain low.

Regarding the contribution to capital formation, only the Telcos presented the requisite data (financial statements/reports) for estimation; a caveat for the interpretation of the outcome.

The telecommunications industry is the largest activity in the ICT sector in terms of GVA, having a share of about 85% of total ICT GVA. The industry's contribution to GDP in 2010 was 2.6% but declined to 1.9% in 2015. Capital formation was noted to be highest in the first referenced year (2010). This makes intuitive sense since the industry requires large initial outlay for their capital-intensive equipment.

Also, using data extracted from government's fiscal data and financial statements of the telecommunication companies, this study revealed that the contribution of ICT (only the mobile telephony and tower activities) to domestic revenue increased from GHS 449 million to GHS 865 million in 2015. The largest share (7.4%) was recorded in 2011. It was further noted that the Telcos employed 37% of the total workforce of the ICT sector (IBES I). This is followed by broadcasting (22%), with software publishing constituting the least in employment generation.

Further analyses of the telecommunication industry, disaggregated into wired and wireless telecommunications (Telcos) activities, tower operations, and other telecommunications services give the following output.

- On the whole, the industry contributed 2.6% to GDP in 2010, but declined to 1.9% in 2014. A breakdown shows that whilst the Telcos activities increased over the period, the towers increased from 2010 to 2012, then declined in the remaining referenced years. Similarly, other telecommunication services increased from 2010 to 2013 before falling in 2014. Components of the GVA for the Telcos also indicate that gross output, fixed capital and intermediate consumption increased annually over the referenced period; but taxes did not. A plausible reason for the latter is deferred taxes for some years.
- The Telcos contribution to domestic revenue was found to be somewhat erratic. Estimates suggested an increase in 2011, then a decline till 2013. This was followed by an increase in 2014 and a subsequent decline in 2015.
- Regarding productivity indicators, the study revealed that material efficiency (a ratio of intermediate consumption to gross output) of the Telcos fell from 2010 to 2012, and sharply increased in 2013. However, the years thereafter observed a gradual decrease. Labour productivity basically showed increasing tendencies throughout the period. This trend can be largely attributed to the continuous increases in capital injection

Finally, the study's forecast indicates that demand for telecommunication services will continue to grow. Whilst telecommunication voice service would tend to record lower average annual growths in both subscription (8.6%) and traffic (9.8%), mobile data subscription and traffic are forecasted to grow annual averages of 16.2% and 42.3% respectively between 2015 and 2020. LTE, which is an emerging technology, is also expected to grow fast; albeit with a relatively high cost of LTE device. The projected average annual growth in LTE data subscription and data traffic is 10.5% and 23.5% respectively between 2016 and 2020.

In summary, our analyses suggest that contribution of the ICT sector to the Ghanaian economy seems satisfactory when compared to that of a country like South Africa. However, compared to a developing country like Malaysia, the performance of the ICT sector in Ghana is very low. ICT sector GVA for Malaysia has been over 10% of total GDP from 2010 to 2015. Employment in the ICT sector contributed 7.7% of total employment in Malaysia, while it is only 1.2% of household employment in Ghana (2014). Malaysia's ICT goods imports and

exports were also 22.3% and 25.5% of total imports and exports respectively in the same year.

6.2 Lessons learnt

Satellite accounts enable a more comprehensive picture of an economic activity by bringing together components of that activity throughout the economy. Thus, ICT satellite accounts build on existing statistical work, makes use of the existing statistical systems and classifications in order to provide a clear system for producing, presenting and analysing ICT data. It is also clear that ICT satellite accounts have the potential to provide an overarching framework for the development of integrated statistics on the ICT sector, helping ensure consistency between data sets.

One of the major methodological challenges encountered in this study had to do with the availability, quantity and quality of data from existing sources. First, financial statements of some of the establishments lacked the level of detail needed for the study, while some have incomplete financial statements covering all the years being considered for the study. Secondly, the reporting of the existing data in old versions of international standard codes and classifications posed serious challenges to the study. As a result, the data required transformations that were necessary to ensure consistency and integrity of the results.

Another methodological challenge emerged from the use of the SUT. The SUT lacked some details that correspond to the ICT satellite account. This problem emerged because the ICT sector was very small and also lacked detail data at the time of the preparation of the SUT. Again, the SUT classification was based on ISIC Revision 3.1 while the classification for this study is ISIC Revision 4.

The positive side of the two methodological challenges is the discovery of the weaknesses in the national statistical system – data gaps and data inconsistencies.

Forecasting for the ICT sector as a whole was a problem because of non-availability of the minimum number of data points that were needed in order to provide a good forecast of the future.

Despite the data challenges encountered, this report which appears to be the first of its kind in Ghana, provides coordinated pieces of information on the ICT sector, which hitherto were not known. The approach, methodology and findings will help GSS in taking up compilation of additional tables and accounts such as tourism, education and entertainment satellite accounts and enable them to meet the challenges in incorporating emerging activities into the national accounts.

APPENDICES

Appendix A: Key Stakeholders Engaged

Organization	Title of person interviewed	Name of person interviewed	Date of interview
NCA	Deputy Director, Research and Development	Victor Teppeh	Over the course of the study
NCA	Deputy Manager, Research and Development	Emmanuel Larbi Offei	Over the course of the study
GSS	Head of Industrial Statistics Section	Anthony Krakah	20th October, 2016
GRA	Senior Revenue Officer	Constance Tsumasi	8th November, 2016
GSS	National Accounts Section	Felix Debrah	11th November, 2016 5th December, 2016 13th January, 2017
GSS	Director, Economic Statistics Division	Asuo Afram	18th November, 2016 9th January, 2017
GSS	Head of Trade Statistics Section	Samuel Motey	21st November, 2016
Softtribe	Chief Executive Officer	Tetteh Antonio	24th November, 2016
Persol	Finance and Administrative Manager	Francis Ayivi	28th November, 2016
GSS	Data Processing Division	Jacqueline Anum (Mrs)	29th November, 2016
GSS	Trade Statistics Section	Joyce Date (Mrs)	30th November, 2016
DreamOval	Chief Executive Officer	Derrydean Dadzie	11th January, 2017
Rancard Solutions	Head of Corporate Services	Naa Amerley Ashong	16th January,2017
Chamber of Telecommunications	Head of Research and Communications	Derek Laryea	16th February, 2017

Appendix B: List of documents reviewed

Document	Author
Reports and Financial statements	Telcos MTN: 2010 -2015 Expresso: 2010; 2012 – 2014 Glo: 2011 -2012 Tigo:2010 -2015 Airtel: 2010 – 2015 Vodafone: 2010; 2011; 2013; & 2014
	Towers ATC Ghana: 2012 Helios Towers: 2011 – 2013; 2015 Eaton Towers: 2012-2014
	Software developers Softtribe: 2010 – 2015 Persol: 2010-2015
	Broadcasters Multimedia: 2010-2014 TV3; and six others)
Data on call volumes	Telcos (MTN; Expresso; Glo; Tigo; Airtel; Vodafone): 2013 – September, 2016.
List of radio stations	NCA
List of TV stations	NCA
Ghana Living Standards Survey (GLSS)	Ghana Statistical Service (2013)
"Ghana ICT sector performance review 2009/2010", (2010), volume 2, policy paper 8	G. Frempong (2010)
"Telecommunications regulation and broadband development", (2009), IDRC report	Mastrini G. and Aguerre C.
World Economic Forum	Global Information Technology Report (2015)
NCA Quarterly Statistical Bulletin on Communications in Ghana	NCA; April –June 2016

Appendix C: Stakeholder Working Sessions

Session	Attendees	Date
NCA Review of Initial Overview Report	NCA Research and Development Team	5th January, 2017
NCA Review of First Draft Report	NCA Research and Development Team	19th April, 2017
NCA Knowledge Transfer	NCA Research and Development Team	7th February, 2017
Presentation of Results	Representatives from: NCA GSS GRA	26th May,2017
Operator's Working Session	Representatives from: NCA Telcos GSS GRA MoF BoG MoC Surfline Ghana Chamber of Telecommunication	6th June,2017

Appendix D Components of gross value added of the ICT sector

Activity	2010	2011	2012	2013	2014
Manufacturing	31,642,947	27,530,527	12,010,085	22,376,817	18,833,691
Trade	139,597,244	171,630,604	182,692,669	164,936,838	237,872,140
Software publishing	1,213,049	2,184,608	3,096,454	2,973,157	2,388,509
Programming and broadcasting activities	4,390,757	5,810,309	8,607,921	13,113,165	20,392,004
Telecommunications	1,215,856,841	1,438,811,147	1,843,467,094	2,051,813,280	2,173,453,835
Computer programming, consultancy and related activities	15,037,778	15,968,852	15,150,514	28,772,624	31,404,817
Data processing, hosting and related activities; web portals	625,438	834,614	298,386	1,925,062	1,743,566
Repair of computers and communication equipment	2,812,474	11,669,759	4,328,727	6,104,376	3,254,074
Total ICT Gross Value Added	**1,411,176,528**	**1,674,440,420**	**2,069,651,848**	**2,292,015,319**	**2,489,342,635**

Appendix E: Foreign trade in ICT goods

Appendix E1: Value of imports (c.i.f.) of ICT goods by categories

CATEGORIES	2010	2011	2012	2013	2014	2015
Computers and peripheral equipment	177,104,271.38	168,407,473.30	253,797,453.10	252,103,387.00	295,371,453.60	240,363,831.26
Communication equipment	466,852,682.91	630,601,080.20	542,310,263.00	407,667,652.00	620,597,151.00	502,598,605.00
Consumer electronic equipment	70,674,727.92	110,429,709.22	141,838,963.91	185,194,565.41	183,404,118.29	231,834,276.29
Electronic components	38,086,188.27	80,265,573.77	80,692,364.83	62,681,017.02	130,969,185.74	91,106,501.70
Miscellaneous	14,688,543.01	12,941,483.88	13,521,483.36	14,996,222.72	70,926,659.00	52,421,259.00
Total ICT goods	**767,406,413.49**	**1,002,645,320.37**	**1,032,160,528.20**	**922,642,844.15**	**1,301,268,567.63**	**1,118,324,473.25**
Total Imports (all commodities)	**12,287,000,000.00**	**19,065,000,000.00**	**24,421,000,000.00**	**25,002,000,000.00**	**39,458,710,000.00**	**46,830,100,000.00**

Appendix E2: Value of exports (f.o.b.) of ICT goods by categories

CATEGORIES	2010	2011	2012	2013	2014	2015
Computers and peripheral equipment	575,058.19	2,282,937.29	3,201,681.23	18,080,344.58	6,096,320.69	18,889,091.58
Communication equipment	219,292.93	4,858,660.22	8,061,661.47	24,029,959.87	5,373,770.56	4,892,198.27
Consumer electronic equipment	28,746.07	1,868,342.11	1,124,474.54	2,140,155.02	1,480,392.78	837,972.96
Electronic components	255,881.86	3,650,835.05	4,990,819.41	1,034,343.02	4,565,612.23	5,565,432.66
Miscellaneous	35,291.48	301,883.46	183,898.86	133,033.71	140,745.26	466,611.92
Total	**1,114,270.53**	**12,962,658.13**	**17,562,535.51**	**45,417,836.20**	**17,656,841.52**	**30,651,307.39**
Total exports (all commodities)	**7,655,000,000.00**	**20,902,000,000.00**	**27,219,000,000.00**	**24,678,000,000.00**	**39,154,200,000.00**	**45,476,260,000.00**

Appendix F: Model results from EVIEWS

Equation: $\Delta VS_t = \alpha_0 + \alpha_1 \Delta VS_{t-1} + \alpha_2 \Delta VS_{t-2} + \varepsilon_1$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	106240.5	56514.68	1.879873	0.0699
D(VS(-1))	0.463201	0.185947	2.491042	0.0185
D(VS(-2))	0.166768	0.199659	0.835266	0.4102
R-squared	0.251513	Mean dependent var		258891.6
Adj. R-squared	0.201614	S.D. dependent var		155788.1
S.E. of regression	139200.5	Akaike info criterion		26.61173
Sum squared resi.	5.81E+11	Schwarz criterion		26.74777
Log likelihood	-436.0935	Hannan-Quinn criterion		26.6575
F-statistic	0.012965	Durbin-Watson stat		2.012763

Equation: $VT_t = \delta_0 + \delta_1 VS + \delta_2 VT_{t-1} + \varepsilon_2$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.33E+08	4.40E+08	-1.894838	0.0672
VS	101.7016	27.44795	3.705254	0.0008
VT(-1)	0.32029	0.167889	1.907755	0.0654
R-squared	0.795544	Mean dependent var		3.21E+09
Adj. R-squared	0.782765	S.D. dependent var		4.05E+08
S.E. of regression	1.89E+08	Akaike info criterion		41.03221
Sum squared resi.	1.14E+18	Schwarz criterion		41.16553
Log likelihood	-715.0637	Hannan-Quinn criterion		41.07823
F-statistic	62.25628	Durbin-Watson stat		1.959547

(3)Equation: $DS_t = b_0 + b_1 DS_{t-1} + b_2 DS_{t-2} + b_3 t + \varepsilon_3$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.49E+06	1.83E+06	3.554633	0.0013
DS(-1)	0.114303	0.182035	0.627916	0.5348
DS(-2)	0.030504	0.182801	0.166872	0.8686
@TREND	277230.7	84495.45	3.281013	0.0026
R-squared	0.808762	Mean dependent var		1.35E+07
Adj. R-squared	0.789639	S.D. dependent var		3.60E+06
S.E. of regression	1.65E+06	Akaike info criterion		31.58012
Sum squared resi.	8.16+13	Schwarz criterion		31.75969
Log likelihood	-532.862	Hannan-Quinn criterion		31.64136
F-statistic	42.29099	Durbin-Watson stat		2.020489

(4) Equation: $DT_t = \beta_0 + \beta_1 DS + \beta_2 DT_{t-1} + \beta_3 t + \varepsilon_4$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.81E+07	1.33E+08	0.136761	0.8921
DS	-3.977456	15.50993	-0.256446	0.7993
DT(-1)	0.966731	0.10952	8.827004	0.0000
@TREND	10229725	10385078	0.985041	0.3322
R-squared	0.977697	Mean dependent var		1.77E+09
Adj. R-squared	0.975539	S.D. dependent var		9.06E+08
S.E. of regression	1.42E+08	Akaike info criterion		40.48434
Sum squared resi.	6.23E+17	Schwarz criterion		40.6621
Log likelihood	-704.476	Hannan-Quinn criterion		40.5457
F-statistic	452.9876	Durbin-Watson stat		2.303324

(5) Equation: $LTES_t = C_0 + C_1 LTES_{t-1} + C_2 \varepsilon_{5t-1} + C_3 t + \varepsilon_5$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	48864.42	1.12E+04	4.376579	0.0005
LTES(-1)	0.451867	0.141618	3.190737	0.0057
@TREND	605.3296	261.8068	2.312123	0.0344
MA(1)	-0.9997192	0.07938	-12.56228	0.00000
R-squared	0.858031	Mean dependent var		9.64E+04
Adj. R-squared	0.831412	S.D. dependent var		1.57E+04
S.E. of regression	6.46E+03	Akaike info criterion		20.56203
Sum squared resi.	6.69E+08	Schwarz criterion		20.76217
Log likelihood	-201.6303	Hannan-Quinn criterion		20.6019
F-statistic	32.2323361	Durbin-Watson stat		1.654638

(6) Equation: $LTET_t = \psi_0 + \psi_1 LTES + \psi_2 LTET_{t-1} + \psi_3 \varepsilon_{6t-2} + \psi_4 t + \varepsilon_6$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.21E+05	1.51E+05	-0.866109	0.4001
LTES	5.317952	1.63970	3.243246	0.0055
LTET(-1)	0.432754	0.199497	2.169228	0.0465
@TREND	8568.674	8392.902	1.020943	0.3235
MA(2)	0.422032	0.280928	1.502279	0.1538
R-squared	0.923155	Mean dependent var		8.00E+05
Adj. R-squared	0.902663	S.D. dependent var		2.17E+05
S.E. of regression	6.76E+04	Akaike info criterion		25.29279
Sum squared resi.	6.85E+10	Schwarz criterion		25.54173
Log likelihood	-247.9279	Hannan-Quinn criterion		25.34139
F-statistic	45.0493	Durbin-Watson stat		1.426812

Appendix G: Forecasts of monthly subscription and traffic of telecommunication industry voice services

Appendix G1: Monthly forecasts of voice subscriptions

Month	2016	2017	2018	2019	2020
January	35,551,110	38,996,460	42,441,810	45,887,160	49,332,520
February	35,838,220	39,283,570	42,728,920	46,174,280	49,619,630
March	36,125,330	39,570,680	43,016,040	46,461,390	49,906,740
April	36,412,440	39,857,790	43,303,150	46,748,500	50,193,850
May	36,699,560	40,144,910	43,590,260	47,035,610	50,480,970
June	36,986,670	40,432,020	43,877,370	47,322,730	50,768,080
July	37,273,780	40,719,130	44,164,490	47,609,840	51,055,190
August	37,560,890	41,006,250	44,451,600	47,896,950	51,342,300
September	37,848,010	41,293,360	44,738,710	48,184,060	51,629,420
October	38,135,120	41,580,470	45,025,820	48,471,180	51,916,530
November	38,422,230	41,867,580	45,312,940	48,758,290	52,203,640
December	38,709,340	42,154,700	45,600,050	49,045,400	52,490,760

Appendix G2: Monthly forecasts of voice traffic in million minutes

Month	2016	2017	2018	2019	2020
January	4,097,874,000	4,546,882,000	5,037,234,000	5,568,931,000	6,141,972,000
February	4,133,712,000	4,586,166,000	5,079,963,000	5,615,105,000	6,191,591,000
March	4,169,838,000	4,625,736,000	5,122,979,000	5,661,567,000	6,241,498,000
April	4,206,250,000	4,665,594,000	5,166,283,000	5,708,315,000	6,291,692,000
May	4,242,950,000	4,705,739,000	5,209,873,000	5,755,351,000	6,342,173,000
June	4,279,936,000	4,746,171,000	5,253,750,000	5,802,673,000	6,392,941,000
July	4,317,210,000	4,786,890,000	5,297,915,000	5,850,283,000	6,443,996,000
August	4,354,771,000	4,827,897,000	5,342,366,000	5,898,180,000	6,495,338,000
September	4,392,619,000	4,869,190,000	5,387,105,000	5,946,364,000	6,546,968,000
October	4,430,754,000	4,910,770,000	5,432,131,000	5,994,835,000	6,598,884,000
November	4,469,176,000	4,952,638,000	5,477,444,000	6,043,594,000	6,651,088,000
December	4,507,886,000	4,994,793,000	5,523,044,000	6,092,639,000	6,703,579,000

Appendix H: Forecasts of monthly subscription and traffic of telecommunication industry mobile data services

Appendix H1: Monthly forecasts of mobile data subscriptions

Month	2016	2017	2018	2019	2020
January	19,192,760	23,082,840	26,972,920	30,863,000	34,753,090
February	19,516,940	23,407,020	27,297,100	31,187,180	35,077,260
March	19,841,110	23,731,190	27,621,270	31,511,350	35,401,430
April	20,165,280	24,055,360	27,945,440	31,835,520	35,725,610
May	20,489,460	24,379,540	28,269,620	32,159,700	36,049,780
June	20,813,630	24,703,710	28,593,790	32,483,870	36,373,950
July	21,137,800	25,027,880	28,917,960	32,808,050	36,698,130
August	21,461,980	25,352,060	29,242,140	33,132,220	37,022,300
September	21,786,150	25,676,230	29,566,310	33,456,390	37,346,470
October	22,110,320	26,000,400	29,890,480	33,780,570	37,670,650
November	22,434,500	26,324,580	30,214,660	34,104,740	37,994,820
December	22,758,670	26,648,750	30,538,830	34,428,910	38,318,990

Appendix H2: Monthly forecasts of mobile data traffic in Megabytes

Month	2016	2017	2018	2019	2020
January	4,747,203,000	6,462,307,000	9,110,899,000	11,951,760,000	14,920,730,000
February	4,783,772,000	6,673,595,000	9,341,355,000	12,194,990,000	15,172,470,000
March	4,820,629,000	6,886,794,000	9,573,085,000	12,439,070,000	15,424,770,000
April	4,857,776,000	7,101,841,000	9,806,046,000	12,683,960,000	15,677,620,000
May	4,895,212,000	7,318,674,000	10,040,200,000	12,929,650,000	15,931,000,000
June	4,932,936,000	7,537,233,000	10,275,500,000	13,176,110,000	16,184,890,000
July	4,970,950,000	7,757,461,000	10,511,910,000	13,423,310,000	16,439,270,000
August	5,009,252,000	7,979,303,000	10,749,400,000	13,671,220,000	16,694,130,000
September	5,047,844,000	8,202,705,000	10,987,930,000	13,919,830,000	16,949,460,000
October	5,086,725,000	8,427,615,000	11,227,460,000	14,169,100,000	17,205,220,000
November	5,125,894,000	8,653,982,000	11,467,970,000	14,419,030,000	17,461,420,000
December	5,165,353,000	8,881,759,000	11,709,410,000	14,669,580,000	17,718,040,000

Appendix I: Forecasts of monthly subscription and traffic of telecommunication industry LTE data services

Appendix I1: Monthly forecasts of LTE subscription

Month	2016	2017	2018	2019	2020
January	103,404	111,428	124,680	137,932	151,184
February	100,980	112,532	125,784	139,037	152,289
March	101,851	113,637	126,889	140,141	153,393
April	104,004	114,741	127,993	141,245	154,497
May	106,726	115,845	129,097	142,350	155,602
June	109,124	116,950	130,202	143,454	156,706
July	103,095	118,054	131,306	144,558	157,810
August	103,485	119,158	132,410	145,663	158,915
September	105,216	120,263	133,515	146,767	160,019
October	106,612	121,367	134,619	147,871	161,124
November	108,458	122,471	135,724	148,976	162,228
December	109,729	123,576	136,828	150,080	163,332

Appendix I2: Monthly forecasts of LTE data traffic in Gigabytes

Month	2016	2017	2018	2019	2020
January	700,906	1,111,440	1,416,949	1,722,457	2,027,965
February	714,280	1,136,899	1,442,408	1,747,916	2,053,424
March	844,629	1,162,358	1,467,867	1,773,375	2,078,883
April	868,939	1,187,817	1,493,326	1,798,834	2,104,343
May	886,417	1,213,276	1,518,785	1,824,293	2,129,802
June	893,618	1,238,735	1,544,244	1,849,752	2,155,261
July	920,793	1,264,194	1,569,703	1,875,211	2,180,720
August	993,701	1,289,653	1,595,162	1,900,670	2,206,179
September	1,062,190	1,315,112	1,620,621	1,926,129	2,231,638
October	1,058,905	1,340,571	1,646,080	1,951,588	2,257,097
November	1,075,006	1,366,030	1,671,539	1,977,047	2,282,556
December	1,146,446	1,391,489	1,696,998	2,002,506	2,308,015