ERP - Organizational Readiness Report

Development of ERP System for PDS – a MiDA Ghana Project

Additional Information in Support of the IFB v1.0 Submitted
on 29 July 2019

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Revision	Comment	Author	Date
v.1.0	Final Report	Helge Habenicht	28.02.19
v.1.0	Additional Information in Support of the IFB v1.0	Helge Habenicht	29.07.19

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Abbreviations / Acronyms and Definitions

Table 2: Abbreviations / Acronyms and Definitions

Abbreviations / Acronyms / Definition	Comment
AP	Accounts Payable
AR	Accounts Receivable
BA	Business Area, e.g. Financial Accounting
BoD	Board of Directors
BOQ	Bill of Quantity
BP	Business Process
BPM	Business Process Modelling
BPMN	Business Process Modelling Notation
BSP	Bulk Supply Point
CoA	Chart of Accounts
CRE	Customer Relationship Executive
CSC	Customer Services Centre
CSM	Customer Service Management
DCCN	Data Centre & Communication Network
DM	District Manager

DMD	Deputy Managing Director
DSTO	District Technical Operations
DTO	District Technical Officer
ECG	Electricity Company of Ghana (now PDS)
ED	Estates Division
EFOT	PDS Financial and Operational Turn Around
EMS	Enterprise Management System
ERP	Enterprise Resource Planning
FI	Financial
GEDAP	Ghana Energy Development and Access Project
GL	General Ledger
GM	General Manager
GPS	Global Positioning System
GRN	Goods Received
HO / HQ	Head Office / Head Quarter
HR	Human Resource
HV	High Voltage
IFRS	International Financial Reporting Standards
IT	Information Technology
LV	Low Voltage
MD	Managing Director
MDM	Meter Data Management
MiDA	Millennium Development Authority
MV	Medium Voltage
OJT	On the Job Training
PM	Preventive Maintenance
PO	Power Optimisation
PoS	Point of Sale
PSP	Public Sector Participation
Abbreviations / Acronyms / Definition	**Comment**
R&D	Research and Development
RGM	Regional General Manager
SCADA	Supervisory Control and Data Acquisition
SPD	System Planning Division
SRV	Store Requisition Voucher
Sub-T	Sub-Transmission
TB	Trial Balance
ToR	Terms of Reference
UI	User Interface
UX	User Experience

1. Readiness Factors and Assessment

__Note to Bidder:__ this document is additional information only and presents the holistic approach to the ERP project and incorporates Core and Optional Requirements. Please adhere to the definitions in the IFB.

The introduction of new administrative technologies has a severe impact on any organisation. In the case of PDS and the planned ERP we see a quantum leap from today's status quo to the envisaged end point of the implementation. Change management is the people and process side of any organizational change that affects people and addresses resistance to change.

In order to prepare, equip and support PDS to successfully adopt change in order to drive the ERP to successful outcomes a structured approach is required: to move (people) from their current state to their future state.

As a first step it requires a change readiness assessment analysing the level of preparedness of the organisation, attitudes and resources at all levels the ERP system needs for change to happen successfully.

The factors relevant in our case are described and evaluated in the following sections.

1.1 Readiness Factors

The following 16 readiness factors have been identified as being significant with respect to the ERP implementation and its effects on PDS.

1) Leadership

2) Strategic Focus

3) Change Management

4) Culture

5) Middle Management

6) Manpower Management

7) Organisation Structures

8) Policies

9) Corporate Governance

10) ERP Project Governance

11) Stakeholder Management

12) Business Process Management

13) Procedures

14) Communications

15) Training/Skills

16) IT Capacity to execute

1.2   Readiness Factors and Maturity Model

The Readiness Factors have each been set out in the following Maturity Model with 5 levels:

Table 3: Five readiness levels

Level 1: Initial State (As-Is)	Level 2: Commence	Level 3: Repeatable	Level 4: Managed	Level 5: Optimised (To-Be)
Where we consider the factor to be now in terms of its status condition.	These set out the first and immediate actions to unfreeze the "initial state".	Essentially about measure and structures to take the factor forward.	The processes and procedures to manage the factor in future.	This is a vision of the ideal for the factor and it is where the business should aspire to.

Each factor is set out in the following pages.

1.2.1   Factor Description: Leadership

Leadership is critical for the success of all major business initiatives. The ERP impacting as it does on almost every level of the organisation will need strong leadership signals from the top indicating their support and commitment in a visible proactive manner. The business is currently in the process of introducing a concessionaire who will have full responsibility for managing the business from early in 2019. There are indications that PDS understand their part in the future success of all projects.

Table 4: Factor Maturity Assessment: Leadership

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Minimal to no engagement at executive level as business is transitioning to a Concession.	▪ PDS have thorough briefing on ERP and grasp its ramifications ▪ PDS develop revised Vision, Mission & Values and Business Plans for the business ▪ ERP identified as a major strategic objective in 2019 Business Plan	Executive role incorporates explicit Change deliverable for all management.	Annual Operating Plan which is driven by Vision, Mission and Values and includes Business Plans complete with KPI's and agreed Financial Budgets with the necessary controls and check points in place.	Executive management team fully engaged and actively following a preplanned transformation programme of Leadership, communication, support and engagement. Performance contracts linkage.

1.2.2   Factor Description: Strategic Focus

Experience worldwide indicates that if significant change initiatives are to be successfully implemented, then they need to be enshrined as part of the Company Business Strategy which in turn is the driver for business objectives and for engaging management and staff at all levels.

Table 5: Factor Maturity Assessment: Strategic Focus

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Existing Vision and Strategy but no managed business cycle.	Develop Business Planning infrastructure to include the following - ▪ Mandate clarification ▪ Review of Vision, Values, Mission ▪ External Environment analysis ▪ Internal Environment analysis ▪ Identification of strategic issues ▪ Formulating strategies and plans ▪ Implementation plan ▪ Review and Assessment machinery	Creation of Business and Strategy Planning; Management unit at a senior and influential level.	Development of Annual Operating Plan driven by Strategy and incorporating ▪ Key Corporate Objectives ▪ Departmental Business Plans ▪ Annual Opex and Capex Budget All with KPI's for performance reporting and reporting infrastructure.	Full Corporate Business Planning Cycle.

1.2.3   Factor Description: Change Management

The scale of the change that PDSis experiencing and will continue to experience for some years is unprecedented for the entire company. The ERP itself and its impact on organisation, roles, policies and procedures combined with the other associated projects will demand enormous organisational involvement commitment and support. Add in the impending arrival of PDS and the development of a residual PDS then there will be the makings of a challenging time for all.

Table 6: Factor Maturity Assessment: Change Management

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
No implementation plan or implementation strategy.	Fully scoped change plan and programme needs to be developed as a follow on to this Task 4 report.	Full time Transformation Manager and Office needs to be established.	Develop a Change Project management methodology for use across the organisation with suitable software and manpower capable of being networked.	All critical change issues have been identified and incorporated into a reportable change programme. They are meeting or surpassing targets for time and budget.

1.2.4   Factor Description: Culture

The existing cultural paradigm for PDS is that of an electricity business with a major focus on engineering and perennial financial challenges. The company has an abundance of managers with many layers with limited authority to action and much decision making tends to be centred at the upper levels. Although there is a balanced scorecard regime in operation, there is not enough attention to commerciality or HR capital. The modern approach of a performance driven commercial and customer driven business is lacking. Overall management and staffing reflect this culture leading to sub optimised (To-Be) involvement and commitment at most levels.

Table 7: Factor Maturity Assessment: Culture

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Traditional engineering business with limited delegation, low commercial focus.	Development of new Vision, Values and Mission for the business. Development of a programme to mobilise the organisation behind the new Vision, Values and Mission	Incorporation of Vision, Values and Mission into management deliverables and management job description and competences.	Business Plans and performance reporting reflect the Vision, Values and Mission.	Modern electricity utility that is driven by customer needs, financial viability, modern processes and a workforce that is supportive of company Vision, Values and Mission.

1.2.5 Factor Description: Middle Management Engagement

Middle Managers are the "lynch pin" in any business reorganisation change. They contribute to and are the conduits for Senior Management plans, decisions and strategies. They interact with direct reports and so have a significant influence on what gets said and done - i.e. the culture of the organisation to be. Their role in any planned change is therefore pivotal. It will however only work if the bloated management structure is thinned out and responsibility levels are adjusted.

Table 8: Factor Maturity Assessment: Middle Management Engagement

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Involvement by some in the background workshopping of ERP. Little appreciation of the significant strategic change issues ahead.	All Middle Managers to participate in a Middle Management Development Training programme. Theme: Strategic Business Development for PDS.	Restructuring of Middle Management positions as part of overall re-organisation and new Middle Manager positions filled after interview.	Performance Management process introduced to include performance related pay and performance contracts.	Middle Management cadre proactively push the change agenda in the company and delivering to SMART KPI's.

1.2.6 Factor Description: Manpower Management

Manpower management is about having the right people, in the right numbers, in the right place and at the right time. The ERP, to be successful will require people ready, willing and able to ensure it is operationalized successfully. A strategic business review will also surely have implications for the numbers, type and category of employees going forward.

Table 9: Factor Maturity Assessment: Manpower Management

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Almost non-existent manpower management, information and low management control.	- Detail numbers by category for each level of "As Is" organisation structure - see Organisation Factor. - Review of job roles, positions and functions and development of new Job Descriptions complete with required competences; - Development and agreement of business driven "ToBe" numbers by category for each part of "To-Be" organisation - see Organisation Factor.	Re-develop and Refocus Manpower Planning and Development within Human Resources Department with clear roles and deliverables.	Rolling Manpower plan looking over 5 years with agreed establishment for all Departments setting out target numbers by category.	Active management of organisational staffing targets by means of KPI reporting.

1.2.7 Factor Description: Organisation Structures

The ERP will affect almost every part of the organisation and this impact is illustrated in abstract of the Task 2 final report[1]. Above, under Factor Strategic Focus (see 1.2.2), it is asserted that a change of the scale of an ERP will only succeed if it is part of an overarching Business Strategy, comprising revised Vision, Mission and Values. Delivery of the new Vision will then surely impact on Organisation Structures which is the organisational "vehicle" to deliver it.

Table 10: Factor Maturity Assessment: Organisation Structures

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
▪ Ad hoc organisational development with low strategic consideration in design decisions; ▪ Deep management structure to accommodate promotions rather than strategic considerations; ▪ Poor structure recording and no review process.	▪ Agreed "As-is" Organisational structure, properly recorded; ▪ Review of "As-Is" organisation structures and development of new "To-Be" structures which reflect new business strategies and also ERP impact; ▪ Implementation of new structure based on agreed plan and programme.	Re-develop and refocus manpower planning and development within Human Resources Department with clear roles, responsibilities and deliverables.	Proper recording, updating and management infrastructure for Organisational Structures data and controls.	Strategic business driven organisation structures, systematically developed, recorded, managed and reviewed.

1.2.8 Factor Description: Policies

Policies consist of high-level statements of intent about the matters a business either wants to do or plans to avoid doing, essentially being a list of rules that the organisation and its workforce needs to adhere to. Policies focus on the intentions of an organisation, not on the functions its workers carry out.

ERP systems work will have implications for existing policies or may generate the need for new ones.

Table 11: Factor Maturity Assessment: Policies

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Disparate policies throughout the organisation which are developed as need arises. Little proactive management.	All policies reviewed and amended as appropriate with attention to new Company Vision, Values and Mission and ERP connection.	Policy management assigned to various management across the organisation as part of their roles.	Rolling prioritised review of policies linked to departmental business plans.	Suite of organisational policies which are enshrined in company vision values and mission and are systematically reviewed for relevance.

1.2.9 Factor Description: Corporate Governance

The Board of PDS is and will be an important player in the management of PDS as they enter the next phase of development. Corporate Governance is important as is clarity of mandate which

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[1] Refer to document 20190729-ECG ERP T2 To-Be Processes v1.0.pdf

is about the relative responsibilities and functions of the Board, Chairman, Managing Director and Executive.

Table 12: Factor Maturity Assessment: Corporate Governance

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Existing Board in place. Appointment of PDS as concessionaire is a major change to the corporate Governance environment.	Develop a revised Board Charter which would include ▪ Board Profile ▪ Chair and Vice Chair role ▪ Company Sec role ▪ Board Committees ▪ External Auditor ▪ Board Meetings ▪ Code of Conduct ▪ Conflicts of interest ▪ Committee charters Review the Board's strategic role and assess the Board's ability to independently evaluate management actions and plans including a review of the Board's operating structure, subcommittees and how the Board interfaces with management.	Establishment of professional Board Secretarial function to develop, plan and programme for the Board and its operation.	Established performance targets for the Board and develop reporting to owners and shareholders.	Modern professional Board working to international standards and Ghana Law enshrined in an agreed Charter with transparent operating and reporting.

1.2.10   Factor Description: ERP Project Governance

Projects of the scope and scale of the proposed ERP demand proper project governance that reflects not only the technical and systems implications, but also considers the "Human Resource" element. Such projects typically have a built in Change Management component fully resourced with staff, systems support and expertise. It requires dedicate leaders with commitment to:

- Set the project direction in the long- and short-term interests of project success

- Take decision and have the authority to ○ Seek evidence ○ Structure process

- Oversee the entire project by ○ Asking the right questions ○ Actively listening ○ Focus on both, details and the final objective

There is a further complication in PDS as their proposed ERP will be launched just as the 20 Year Concession with PDS commences which also needs to be taken into consideration.

Table 13: Factor Maturity Assessment: ERP Project Governance

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Standard Project management Governance with Project Manager focussed almost exclusively on the technical delivery without business relation.	Creation of modern Project Management structure complete with Change Management part with specific allowance for the new management from PDS.	Creation of Transformation Manager position reporting to the PDS Executive.	Systematic reporting to pre-determined technical and change targets.	All projects replete with Change Management element, reflective of PDS Management needs.

1.2.11   Factor Description: Stakeholder Management

A Stakeholder is any individual, group or organization that can affect, be affected by, or perceive itself to be affected by an action, decision or programme. Stakeholder Management plays a critical role for change readiness, in minimizing resistance to change, to increase commitment and buy in from stakeholders for successful change implementation. The stakeholders are divided into primary and secondary stakeholders.

The primary stakeholders being individuals or groups of people who would create a larger influence with regards to PDS within the public sphere, and secondary stakeholders are PDS staff and end users impacted by the project. It is important that the identification and distinction is made with regards to the audiences.

Table 14: Factor Maturity Assessment: Stakeholder Management

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Minimal and ad hoc stakeholder engagement in managing stakeholders' expectations, interest and influence. Stakeholder engagement is happening with no formal stakeholder strategy, analysis/map and plan developed.	Stakeholder strategy developed that includes Power/Interest Model and associated plan.	Stakeholder management assigned to specific individual for strategy ownership and to individuals for managing relationships with stakeholder groups.	A stakeholder management model and process is in place with clear engagement objectives for stakeholder groups and a reportable programme.	Effective stakeholder management and engagement exists at all levels of the organization. There is an organisation wide acknowledgement of changes underway. Executives are visibly and actively engaging stakeholders.

1.2.12   Factor Description: Business Process Management

The focus of the ERP is essentially to integrate and consolidate all existing components of enterprise management systems and processes into one functional system for efficient executive decision making.

Table 15: Factor Maturity Assessment: Business Process Management

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
▪ Ad hoc responses to process management needs ▪ Business Process Management operates in silos.	▪ "As-Is" operational processes and work methods identified and documented ▪ Analyse current business systems that need improvement and recommend more efficient business systems as required ▪ Adopt to the proposed ERP system	Development of excellent Business Process Management expertise capable of working on and sustaining a modern integrated BPM across the company.	Project Implementation governance and reporting structures instituted.	BPM infrastructure within PDS operating across the organisation and working to the best international industry standards for ERP.

1.2.13 Factor Description: Procedures

Procedures define how work is performed. They are typically documented in a step by step order with detailed descriptions of how the work is to be performed and who is responsible for performing the work. Procedures support policies and processes but can also exist without a corresponding policy or process entity. Procedures are typically documented during the implementation of the chosen ERP system and should be completed before training of end-users commences. Procedures form part of a training programme.

Table 16: Factor Maturity Assessment: Procedures

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Disparate range of procedures across the organisation with the minimum proactive review.	Establishment of SubProject within the ERP implementation to identify and document relevant procedures. Completion of Training Needs Analysis and Training Plan.	Assignment of responsibility for departmental procedures to specific managers and development of professional institutionalised relationship with IT process people.	Rolling prioritised review of procedures based on business needs included in departmental business plans.	Procedure optimisation becomes a strategic objective for the business.

1.2.14 Factor Description: Communications

Building awareness of the ERP implementation with all related and accompanying projects taking place within PDS is vital to create understanding of changes with the aim to shifting the perceptions and ensure adoption. All stakeholders should be engaged and be willing to support the envisaged changes with regards to strategy, structure and systems.

A communication strategy is necessary to cut across multiple projects providing a holistic view of all stakeholder groups on change drivers, the need and personal and organisational benefits for change and reporting on progress and achievements.

Table 17: Factor Maturity Assessment: Communications

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
There is limited awareness on the nature of change brought about by the ERP implementation. Communications from the project is not in structured. Presentations are typically infrequent and happening ad hoc. Some communications with respect to PDS impending arrival has commenced.	Overall Communications strategy developed along with Communications plan. Communication plan to serve as guideline and roadmap for implementation to disseminate key messages on key strategic objectives to stakeholders using suitable channels.	Design and Delivery of Communications assigned to a Communications Manager.	Plan reporting against targets.	Communication is a strategic factor for PDS. Communication planning and processes are incorporated in leadership communication processes.

1.2.15   Factor Description: Training/Skills "Change" and Competences

Before and during organizational change, the skills/competencies and capabilities required to align and sustain the change come into sharp focus. Change itself will become a management competence that will need developing. Any technological / systems / procedures / policy changes will require training to support staff to adapt to changes. These trainings will be needed before and during the change process.

Table 18: Factor Maturity Assessment: Training/Skills "Change" and Competences

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Existing training is focussed on "steady state" business needs and not especially driven by change.	Training Needs Analysis and Training plan for: ▪ Before- to condition management on the Change competence and to align them strategically; ▪ During- The practical training needs required to implement new systems and associated procedural/policy changes.	Professional Training Needs Analysis capacity established and established as a competence in PDS.	Training Plans developed with full specifications and approved budgets and deliverable targets. Training delivery reporting against targets.	Training is a stated strategic goal, and leadership make this a priority. Continuous improvements are enabled through training, at all levels of the organization.

1.2.16   Factor Description: IT Capacity to execute

The ERP system will make considerable demands on the IT. This will be in addition to the normal day to day demands on IT. The infrastructure to support the ERP will also be a significant factor in its successful delivery. Having the right IT people in sufficient numbers with the right skills is an imperative going forward.

Table 19: Factor Maturity Assessment: IT Capacity to execute

Initial State (As-Is)	Commence	Repeatable	Managed	Optimised (To-Be)
Inadequate infrastructure and sub-optimal skills.	IT Business strategy and plan. ▪ Access the IT "As-Is" structures in terms of Policies, Processes and Procedures ▪ Review of IT "As-Is" structures and development of new "To-Be" structures which will reflect a new IT strategy and also impact the ERP relevant infrastructure ▪ Implementation of new structure based on agreed functional requirement recommendations	Review IT Department organisation and put in place a plan including - ▪ Roles and Responsibilities ▪ Skill sets ▪ Numbers ▪ Recruitment plan ▪ Training needs analysis ▪ Training plan Annual business plan with targets.	Development of performance reporting against business plan targets.	PDS has the IT resources in terms of people, processes and infrastructure to deliver current and planned IT needs going forward.

PDS has implemented multiple IT projects that are not integrated. The systems aim simultaneously at the same target audience, with no proper training and transfer of skills. Multiple projects can lead to change fatigue resulting in poor adoption rates due to lack of structured change management process to manage the people side of change.

IT people, processes and infrastructure are not only important factors in the whole process of implementing an ERP system, but they are so much determined by their own change management considerations, that we devoted a specific chapter to this aspect in the functional requirements in the ERP-IT FR Report[2]. For further reference please see chapters 2 and 3 of the said report.

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[2] Refer to document 20190131-PDS - ERP-IT FR Report.docx

2. Evaluation of the Readiness Factors

2.1 Readiness Factor Assessment

Related to the elements and findings in chapter 4, the derived Readiness Factors are first assessed with regards to potential risks in below Table 21. Risks are calculated as priority x severity (likelihood x impact). As a next step we have –in Table 23– connected the factors to Urgency and Difficulty-to-fix.

Table 20: Risk Mitigation Rating (qualitative assessment)

Factor	Risk	A: Priority / Likelihood * (1 to 10)	B: Severity / Impact* (1 to 10)	Total AxB	Proposed Mitigation
Leadership (I)	New Management and with it the project sponsor deployment and full engagement is delayed	8	10	80	Engage early with PDS in advance of arrival and taking over from PDS
Leadership (II)	New Management do not engage fully	7	10	70	Escalate to sponsor level
Strategic Focus	Failure to establish strategic context	9	8	72	Engage early with PDS in advance of arrival and taking over from PDS
Change Management	Change infrastructure delayed	9	10	90	Get early and urgent agreement to Change proposals
Culture	Traditional pubic service environment with limited sense of commercial business	7	9	63	Business Plans and performance reporting reflect the Vision, Values and Mission.
Middle Management	Significant numbers of Middle Managers do not demonstrate support for the project	9	9	81	Early planned engagement with each middle manager
Manpower Management	Scale of effort needed is underestimated and results are either late or incomplete	10	9	90	Properly scoped and resourced Change project approved early
Organisation Structures	Scale of effort needed is underestimated and results are either late or incomplete	5	9	45	Properly scoped and resourced Change project approved early
Policies	Policy work delayed or incomplete	4	7	28	Required Manpower resources identified early
Corporate Governance	PDS do not engage on Board Governance	3	8	24	Engage early with PDS in advance of arrival

Factor	Risk	A: Priority / Likelihood * (1 to 10)	B: Severity / Impact* (1 to 10)	Total AxB	Proposed Mitigation
ERP Project Governance	ERP Project Governance structures delayed or ineffective	8	10	80	Activate and train Governance team early.
Stakeholder Management	Change infrastructure insufficient to deliver proper Stakeholder management	8	10	80	Get early and urgent agreement to Change proposals
Business Process Management	Local PDS people to work on ERP of enough expertise and calibre are not available to work on the project	6	8	48	Project manpower plan needed to address needs and fast-track responses
Procedures	Work on procedures is not completed on time and holds up ERP implementation	5	8	40	Required Manpower resources identified early
Communications	Change infrastructure insufficient to deliver proper communications	8	10	80	Get early and urgent agreement to Change proposals
Training/Skills	Change infrastructure insufficient to deliver proper Training	5	10	50	Get early agreement to Change proposals
IT Capacity	IT resources from a technical as well as a human resource point of view are insufficient to deliver project	10	10	100	Urgent project manpower plan needed to address needs and fast-track responses

Urgency, Readiness Status and Degree of Difficulty-to-fix are described below.

Table 21: Readiness Assessment descriptions

Readiness Factor	Urgency	Readiness Status is described as:	Degree of difficulty to fix is expressed as:
16 factors as described above	Urgent = Action needs to be well ahead before ERP implementation starts, i.e. reach Level 4 of the Maturity Model (see chapter 1.2). Phase 2 = Dependent on urgent deliverables	▪ Low: Substantial work required before proceeding ▪ Fair: Needs some work before proceeding, ▪ High: No readiness issues	▪ No issues ▪ Easy ▪ Moderate ▪ Difficult

Table 22: Readiness Assessment Summary

Factor	Risk	Urgency	Readiness Status	Degree of difficulty to fix	Proposed Mitigation
Leadership (I)	New Management and with it the project sponsor deployment and full engagement is delayed	Urgent	Low	Moderate	Engage early with PDS in advance of arrival and taking over from PDS.
Leadership (II)	New Management of PDS do not engage fully	Phase 2	Fair	Moderate	Escalate to sponsor level.

Factor	Risk	Urgency	Readiness Status	Degree of difficulty to fix	Proposed Mitigation
Strategic Focus	Failure to establish strategic context	Urgent	Low	Difficult	Engage early with PDS in advance of arrival and taking over from PDS.
Change Management	Change infrastructure delayed	Urgent	Low	Moderate	Get early and urgent agreement to Change proposals.
Culture	Traditional pubic service environment with limited sense of commercial business	Phase 2	Low	Difficult	Business Plans and performance reporting reflect the Vision, Values and Mission.
Middle Management	Significant numbers of Middle Managers do not demonstrate support for the project	Urgent	Fair	Moderate	Early planned engagement with each middle manager.
Manpower Management	Scale of effort needed is underestimated and results are either late or incomplete	Urgent	Low	Difficult	Properly scoped and resourced Change project approved early.
Organisation Structures	Scale of effort needed is underestimated and results are either late or incomplete	Phase 2	Low	Difficult	Properly scoped and resourced Change project approved early.
Policies	Policy work delayed or incomplete	Phase 2	Fair	Moderate	Required Manpower resources identified early.
Corporate Governance	PDS do not engage on Board Governance	Phase 2	Low	Difficult	Engage early with PDS in advance of arrival.
ERP Project Governance	ERP Project Governance structures delayed or ineffective	Urgent	Fair	Moderate	Activate and train Governance team early.
Stakeholder Management	Change infrastructure insufficient to deliver proper Stakeholder management	Urgent	Low	Moderate	Get early and urgent agreement to Change proposals.
Business Process Management	Local PDS staff to work on ERP with enough expertise and calibre are not available to work on the ERP project	Phase 2	Fair	Difficult	Urgent project manpower plan needed to address needs and fast-track responses.
Procedures	Work on procedures is not completed on time and delays ERP implementation	Phase 2	Fair	Moderate	Required Manpower resources identified early.
Communications	Change infrastructure insufficient to deliver proper communications	Urgent	Low	Moderate	Get early and urgent agreement to Change proposals.
Training/Skills	Change infrastructure insufficient to deliver proper training	Phase 2	Low	Difficult	Get early and urgent agreement to Change proposals.

IT Capacity	IT resources from a technical as well as a human resource point of view are insufficient to deliver project	Urgent	Low	Difficult	Urgent project manpower plan needed to address needs and fast-track responses.

More than 50% of the factors are in the Urgent category as each of them requires actions to reach a high maturity level before the ERP implementation can begin. The other factors classified as Phase 2 are dependent on deliverables derived from solving Urgent matters.

Half the factors are classified as "difficult to fix" and half as „moderate to fix". This will reflect on the amount of time and effort that is required to change their readiness status, as most factors have a Low readiness status.

As the table shows the most important elements and factors to instantly engage with are:

- Strategic Focus
- Manpower Management, and a solution for
- IT Capacity

ERP To-Be Business Processes

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GPS	Global Positioning System
GRN	Goods Received
HO / HQ	Head Office / Head Quarter
HR	Human Resource
HV	High Voltage
IFRS	International Financial Reporting Standards
IT	Information Technology
LV	Low Voltage
MD	Managing Director
MDM	Meter Data Management
MiDA	Millennium Development Authority
MV	Medium Voltage
PM	Preventive Maintenance
PO	Power Optimisation
PoS	Point of Sale
R&D	Research and Development
RGM	Regional General Manager
SCADA	Supervisory Control and Data Acquisition

Abbreviations / Acronyms / Definition	Comment
SPD	System Planning Division
SRV	Store Requisition Voucher
Sub-T	Sub-Transmission
TB	Trial Balance
ToR	Terms of Reference
UI	User Interface
UX	User Experience

1.   Presentation of the To-Be Processes

__Note to Bidder:__ this document is additional information only and presents the holistic approach to the ERP project and incorporates Core and Optional Requirements. Please adhere to the definitions in the IFB.

The "To-Be" processes documented herein follow a structured approach and are grouped into main Business Areas (BAs) as presented and agreed upon in various presentations and meetings. We will highlight the following sections:

- Cross Functional Processes with overall and recurring relevance

- Commercial & Service Management

- Financial Accounting

- Procurement & Materials Management

- Engineering & Capital Projects

- Project Management System

- Enterprise Asset Management

- Estate Management

- Premises

- Fleet Management

- Management Accounting

- Human Capital Management

2.   Business Process Narratives

ERP systems do need a high degree of standardisation or it will be very complex and costly to adapt the required functionalities. In order to achieve that we have designed the processes along these steps:

- Sub-processes, which have a comprehensive, process overarching functionality, and -

The actual ERP module related business processes.

They are explained in detail in the following tables and BPM flow diagrams. It should be noted that even though both components – tables and BPM diagrams – should be read in conjunction, the BPMs take the lead in the interpretation and might even require verbal explanations, they will be answered during the pre-Bid Conference.

2.1   Sub-Processes

Sub-processes are reachable from other processes. The reason we have defined certain processes as sub-processes is to standardise their functionality. We have recognised during our

reviews that more often than not certain processes – which are meant to have the same purpose – are handled differently throughout ECG.

Since such a method for achieving tasks is posing a significant risk to ECG, we have opted to standardise the following processes:

- The various approval processes

- Registration of business partners ("Vendor" Registration)

- Field Service / Workforce Management (as an overall and upgraded commercial service)

- Asset Disposal

- Legal Reviews

They are described in the following chapters.

2.1.1 Approval Process

To follow best practise all processes are designed in such a way that transparency is increasing while at the same time more responsibility is required from the employee. That does not mean their approvals have been eliminated but it is suggested to adopt a four-eye-principle with clearly defined threshold levels regulating who is entitled to approve what.

Table 3: Approval Process

Descriptor	Details
Process Name	Approval Process
Description	▪ The approval process is a general sub-process that is built into all main processes as the standard approval procedure.

	▪ The requesting organisational unit submits any type of document for approval to the first signatory, who reviews the documents. If comments are raised the documents are reverted back to the requested department to adjust the documents. ▪ If the documents are to be approved, they are submitted further on for the 2nd signatory. Here the same document review procedures are taking place as in the first instance. The documents are returned to the point of origin with the requesting department involved.
Goal	The goal is to standardise the approval process and make it compliant with ERP best practises.
Assumptions	Underlying principle is a two-stop approval process that complies with standard ERP procedures. Reason being that we should not apply several different approval processes w/o necessity.
Interfaces	There are interfaces to the various sub-processes and ERP modules required. No interfaces are required to third party modules.
Components	The process is a component of most of the other processes.
Data Sources	All ERP modules.
Start Event (triggered by)	Whenever an approval is required or prescribed if a certain threshold is reached.
Inputs	Typical inputs include: materials requests, procedures, people, methods, information, specifications

Name	Source	Frequency	Volume	Media
Approval request with documents attached	Various ERP Modules	Daily	Unknown	Part of the initiating module from the ERP system

Outputs	Examples of outputs include: approval of requests, products or services requirements				
	Name	**Destination**	**Frequency**	**Volume**	**Media**
	Approved request	Requesting department	Daily	Unknown	Email message to initiating department via the ERP System
	Disapproved request	Requesting department	Daily	Unknown	Email message to initiating department via the ERP System
Reporting	The reports may include: ▪ Maintaining an activity log ▪ Weekly status reports ▪ Time to approve report ▪ Approval status and data ▪ Activity events and milestones				
Complexity	Low				
Organisational or Process Alignment	The approval process needs to be integrated into all processes as standard procedure.				
Roles Involved	All departments and 1st plus 2nd signatories				

2.1.1.1   Flow Diagram Process – Approval Process

Figure 1: Flow Diagram: Approval Process
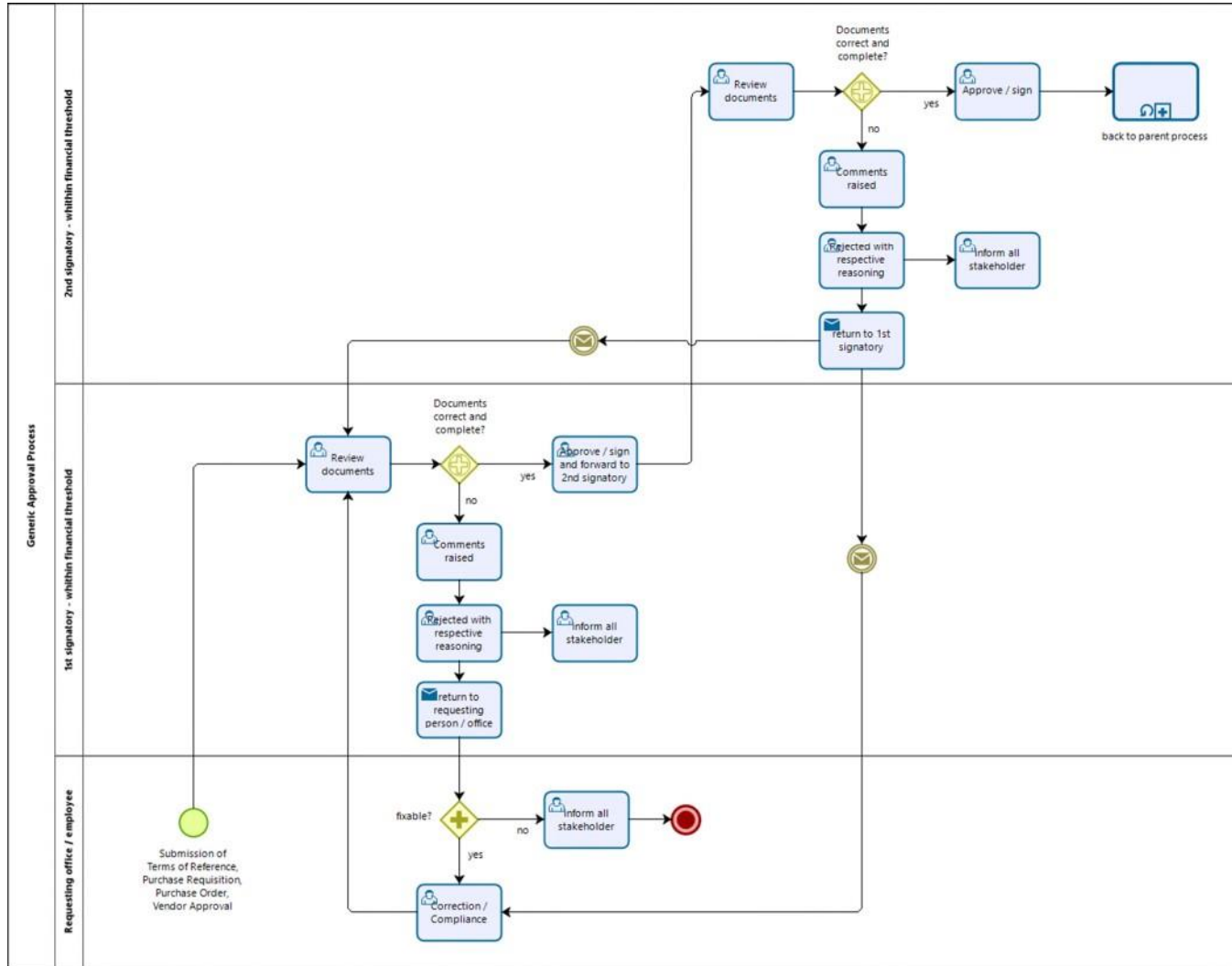
2.1.2 Vendor Registration

In order to ensure delivery of goods, works and services at the desired ECG quality and costs, ECG registers suppliers, vendors and contractors that meet its minimum requirements. It also helps ECG have a pool of qualified firms and business partners available to work on projects.

Similarly, pre-paid vendors also need to go through this process to get registered.

Table 4: Vendor Registration

Descriptor	Details
Process Name	Supplier / Vendor / Contractor Registration

Description	All suppliers / vendors / contractors (parties) who are interested in doing business with ECG have to be registered with them in a prequalification process, as follows:
	▪ Interested parties fill in the registration (online or downloadable) form and submit and submit the following documents:
	   o Certificate of Registration of Business
	   o Ministry of Works and Housing Certificate o SSNIT Clearance Certificate
	   o Current Tax clearance certificate o Organisation structure of the company
	▪ Interested parties shall pay a registration fee, the amount still needs to be decided upon.
	▪ Interested parties completed online forms and make payment in the accounts section for processing.
	▪ If the interested party has not filled the registration forms correctly and/or if it has failed to submit a complete set of all mandatory documents, then the application for registration is rejected and returned to the interested parties with objections.
	▪ If the registration form is complete and filled correctly and all mandatory documents have been submitted, then it is checked whether any previous records of the interested parties exists or not.
	▪ In the case if record exists then it is checked whether the interested parties are flagged (blacklisted) for poor performance or not. If the interested parties are flagged, then further processing is halted, and case is filed.
	▪ In the case where interested parties are not flagged and the registration form is complete and filled correctly and all mandatory documents have been submitted then a responsible team is constituted to visit and inspect the office premises, warehouses or yards of the interested parties to verify strengths of the applicants.
	▪ If the inspection committee is not satisfied with the findings then the registration is not processed and objections are shared with the applicants otherwise registration is approved, and registration certificates is issued in the parties favour.
	▪ Vendor master database automatically stands updated.

Goal	This process helps that internal operations relating to all procurement are done from vendors/suppliers/contractors whose technical and financial strengths have already been gauged by ECG and found to be of the level where ECG business and operations will not get hurt due to any short comings on the part of vendors/suppliers in providing the required materials and services.
Assumptions	There are no known assumptions for this process.
Interfaces	This process is required to interface with the following other processes: ▪ Capital Projects contractor registration process ▪ Pre-paid vendor process ▪ Tender process
Components	Process is a component of the: Procurement Process
Data Sources	This process does not collect information from any other data sources.
Start Event (triggered by)	Receipt of filled registration forms and copies of mandatory documents

Inputs	Name	Source	Frequency	Volume	Media
	Filled Supplier / Vendor registration forms	Suppliers/vendors	Once annually	100	Paper and/or Web based

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Outputs	Name	Destination	Frequency	Volume	Media
	Registration certificate	Suppliers/Vendors and	Once annually	100	Paper and/or email

Reporting	Registered Suppliers/Vendors information stored in database.
Complexity	The complexity of the business process is low.
Organisational or Process Alignment	Organisational adjustments are required in the procurement department to accommodate this process. It needs to be clarified how to flag and de-flag a vendor, under which conditions, who approves and who removes a flag.
Roles Involved	▪ Accountant ▪ Procurement Manager ▪ General Manager Procurement ▪ Director Procurement

2.1.2.1 Flow Diagram Process – Vendor Registration

Figure 2: Flow Diagram: Vendor Registration

ERP To-Be Business Processes
Development of ERP System for ECG – a MiDA Ghana Project Section:
Main
ERP To-Be Business Processes
Development of ERP System for ECG – a MiDA Ghana Project Section: Main
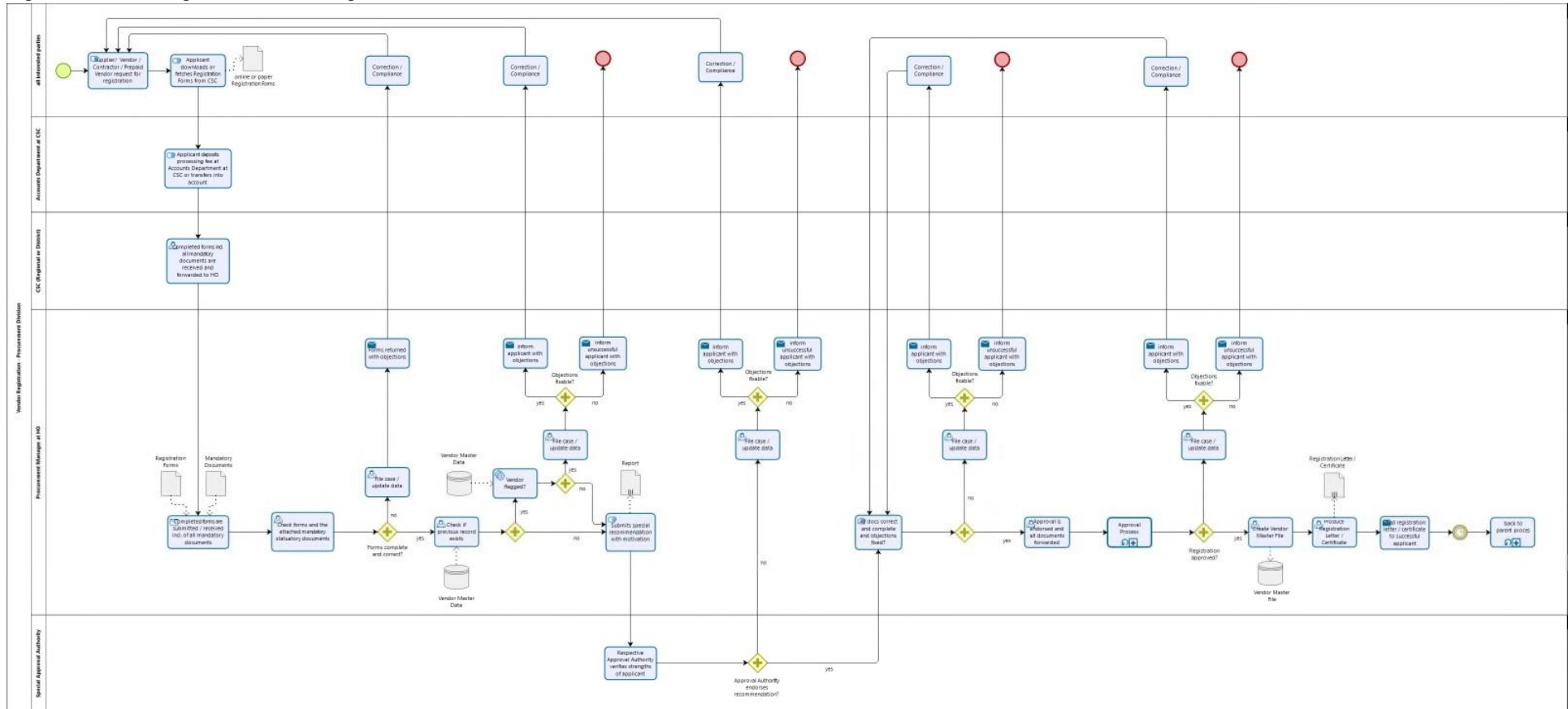
2.1.3   Field Service / Workforce Management

Field Service & Workforce Management will in future be the centrepiece of ECG that helps to maintain a comprehensive overview of equipment, inventory, and special resources to ensure effective and real-time responses to issues effecting electricity supply to its customers. The module consists in essence of three parts:

- a service centre to deal with customers

- access to the workforce schedules

- material management functionalities

Table 5: Field Service / Workforce Management

Descriptor	Details				
Process Name	Field Service / Workforce Management				
Description	The process receives customer requests of any nature, which can be personally or via phone or internet and deals the requests by organising the resolution of the matters. In order to be able to do that the Field Service section needs to have access to the required resources, i.e. people and material.				
Goal	The objective is to resolve customer queries in the shortest possible time.				
Assumptions	Field Service need priority access and authority to delegated and allocated resources to service tasks.				
Interfaces	The process interfaces with: - Customer Ledger - Material Ledger - Procurement system - Fleet Management - Enterprise Asset Management - Workforce and Shift Management system - Service Order system - HR-System				
Components	The process has three components: - Customer Service via CSC or Call Centre Functionality - Material Management - Access to service orders, job cards and shift allocation				
Data Sources	Data are obtained via all interfaces mentioned above				
Start Event (triggered by)	The process is triggered by - A customer query - Annual Maintenance Chart				
Inputs	**Name**	**Source**	**Frequency**	**Volume**	**Media**
	Customer query / Field Orders	Call or Service Centre	daily	10000	Direct customer contact
	Workforce allocation	Field Service	daily	5000	ERP Module
	Scheduled Maintenance	Maintenance Schedule	weekly	5 per month per location	ERP EAM Module
	Material Allocation / reservation	Material Management	daily	2000	ERP Module

Outputs	Name	Destination	Frequency	Volume	Media
	Service Order / Job Cards	Technicians	daily	5000	ERP System Workforce management Module. Reports and material needs transferred via mobile app
	Finance	Financial accountants	daily	3000	Service Order via ERP System
	Project Costing	Management Accounting	daily	Big Data	ERP Mgmt Acc via posting against the actual asset or asset category

Reporting	The reports may include: ▪ Maintaining an activity log ▪ Weekly status reports ▪ Time to approve report ▪ Approval status and data ▪ Activity events and milestones
Complexity	High
Organisational or Process Alignment	Dependent on the volumes involved a thorough investigation on how Field Service and Workforce Management is going to be organised in future required. The significant change in the organisation will happen and needs to be adequately communicated to highlight the opportunity.
Roles Involved	▪ Control Supervisor ▪ Shift Heads ▪ Mobile Teams ▪ Maintenance Supervisors ▪ Field Service Officer

2.1.3.1 Flow Diagram Process – Field Service / Workforce Management

Figure 3: Flow Diagram: Field Service / Workforce Management
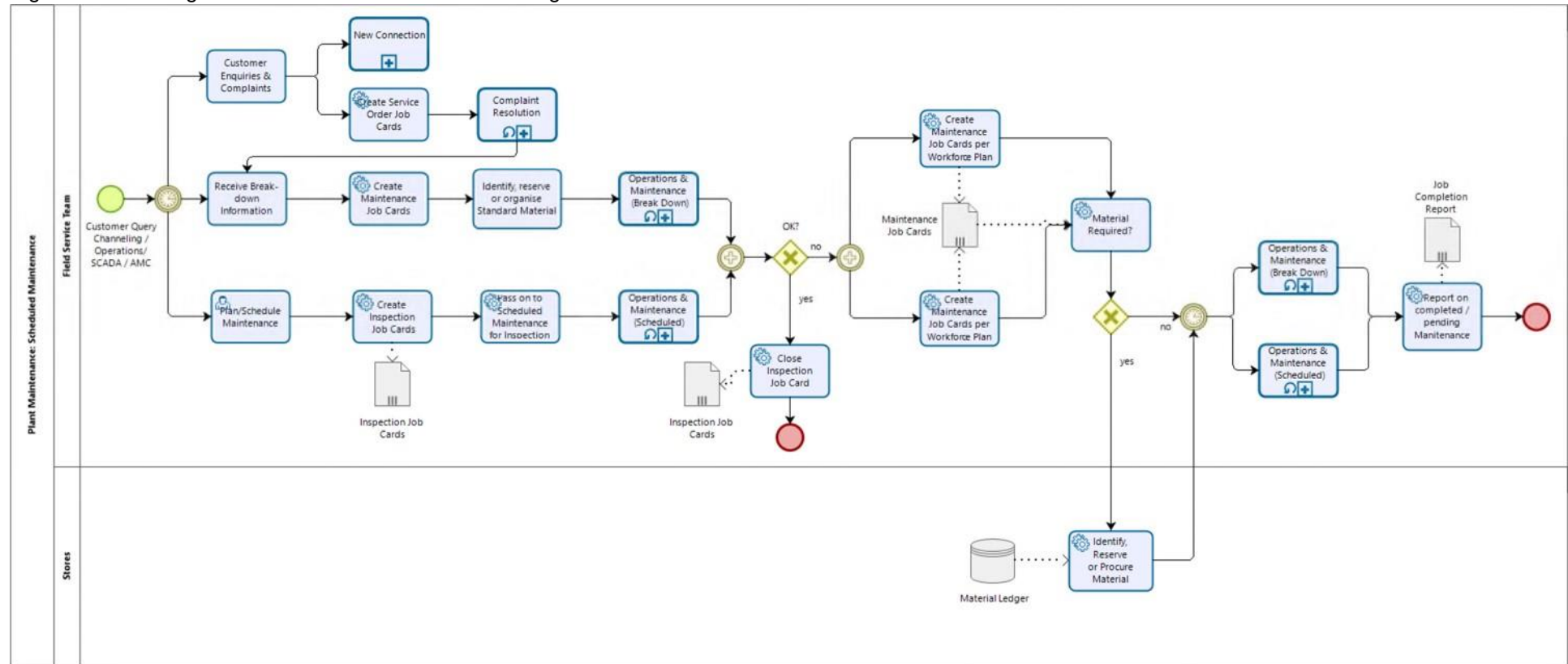
2.1.4   Asset Disposal

All assets reach their end of life-time, and in private companies the life-time of assets is usually longer than in public hands. Therefore, public assets are often still in usable condition when they are disposed of.

Table 6: Asset Disposal

Descriptor	Details				
Process Name	Asset Disposal				
Description	The process is a straightforward disposal / auctioning process of damaged or written off assets.				
Goal	The objective is to generate some additional cash inflow from written off assets.				
Assumptions	The assumption is that this will be a formal process				
Interfaces	The process interfaces with: ▪ Fixed asset register ▪ Fleet management ▪ G/L				
Components	It consists of an approval process deciding whether the asset (mostly vehicles) can be reused – even though they are written off.				
Data Sources	Asset Register				
Start Event (triggered by)	Asset classified as broken and beyond repair or end of life cycle.				
Inputs	**Name**	**Source**	**Frequency**	**Volume**	**Media**
	Asset collection	Asset Register	Usually done biannually	individual	Digital format from ERP system and support bysystems
	Asset consolidation	Asset Register	Usually done biannually	individual	
Outputs	**Name**	**Destination**	**Frequency**	**Volume**	**Media**
	Disposal approval	Asset Auctioning Ledger	Usually done biannually	individual	Digital format from ERP system and support bysystems
	Auctioning	external	Usually done biannually	individual	
Reporting	The reports may include: ▪ Approval status and data ▪ Activity events and milestones ▪ Auctioning results				
Complexity	Low				
Organisational or Process Alignment	The asset disposal needs to be formulised across the ECG organisation				
Roles Involved	Asset owner Approving managers				

2.1.4.1   Flow Diagram Process – Asset Disposal

Figure 4: Flow Diagram: Asset Disposal
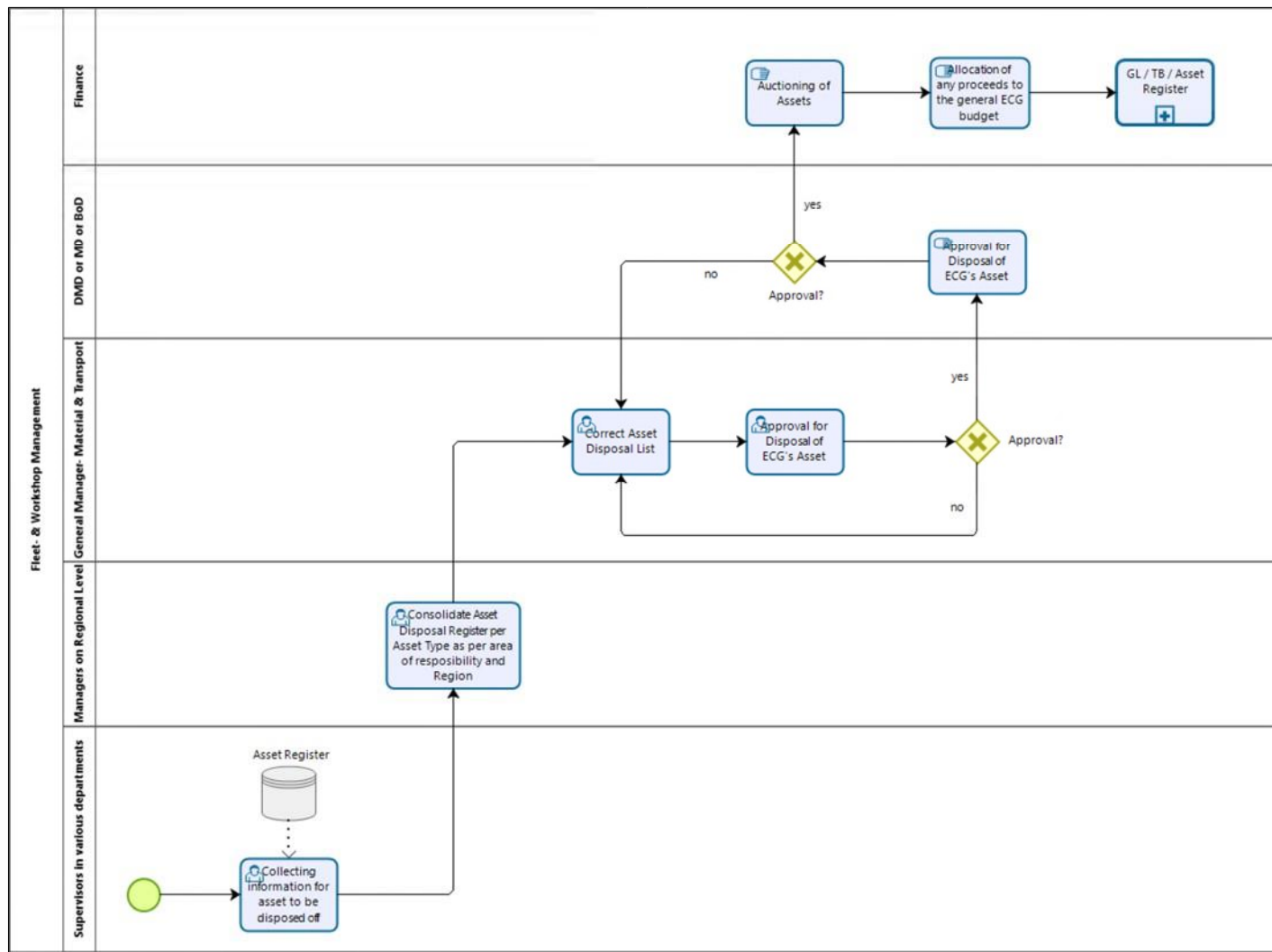
2.1.5   Legal Review

The process deals with the required legal review in any form and shape. All over ECG's operation there is the requirement of getting a legal opinion on certain contractual matters and other circumstances. The process is therefore a sub-process which can be executed at certain milestones in other main processes.

Table 7: Legal Review

Descriptor	Details
Process Name	Legal Review
Description	The process is defined as a sub-process to be integrated in all main processes where a legal advice or clearance is required.
Goal	The objective is to strengthen legal compliance and to avoid unnecessary legal conflicts with third parties.
Assumptions	That in future certain assumption be introduced in which a legal clearance is mandatory
Interfaces	No direct interface to the ERP besides the fact that procedures or events are going to be flagged when legal advice is required.
Components	N.A
Data Sources	Documentation of certain tasks.
Start Event (triggered by)	The process is triggered by a request from an advice requiring entity.
Inputs	Typical inputs include: supporting documents. No direct interlink to the ERP system.
Outputs	Examples of outputs include: approval of legal requests by countersigning. No direct interlink to the ERP system. Some tasks might be flagged to have received a legal opinion and legal clearance.
Reporting	The reports may include: ▪ Approval status and data ▪ Activity events and milestones
Complexity	Low from an ERP point of view.
Organisational or Process Alignment	N.A.
Roles Involved	▪ Requesting unit ▪ Legal advisor

2.1.5.1 Flow Diagram Process – Legal Review

Figure 5: Flow Diagram: Legal Review
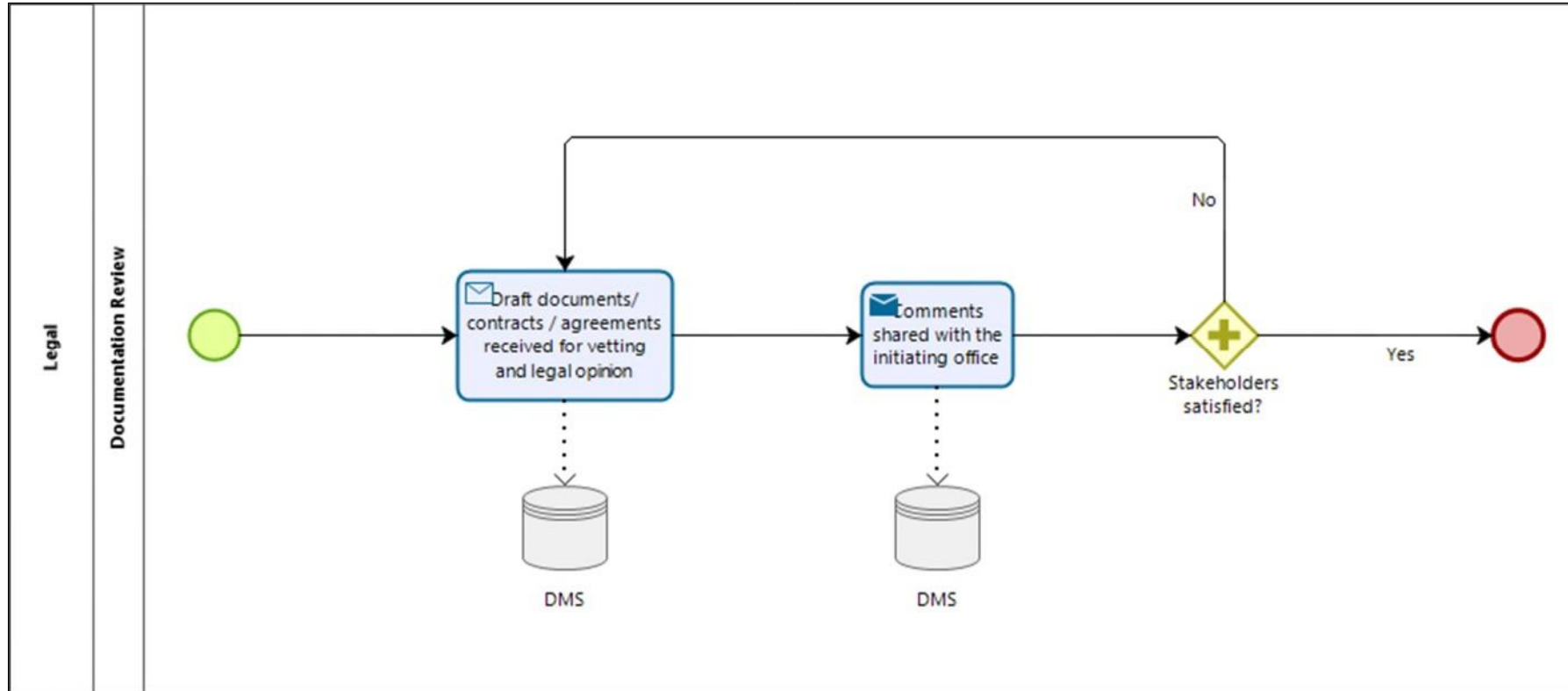
2.2 Commercial & Service Management

In the As-is assessment Commercial Services are a combination of technical and financial services. In the to-be processes the technical part of the electricity sales to ECG's customers serves as the connection point to the accounts receivable process.

Consequently, all technical parts have been separated from the financial part of the operation which are summarised under the Financial Accounting section (see point 2.3). The tasks will be significantly upgraded to an appropriate technical service and workforce management process centre by combining all technical resolution processes in a "Field Service Centre".

Since, we recently learned that ECG has already various parts of a Tier-1 ERP system named Oracle-E-Business Suite (EBS), we have extended the future functionality of "Commercial & Service Management" even further and the new Commercial & Service Management function will be a modern, centre point which entails:

- Customer Channelling (new)
- Field Service / Workforce Management (new)
- Enquiries & Complaints
- Complaint Resolution
- New Connection (Application)
- New Connection (Execution)
- Post-Paid Meter Reading

The processes are described in the following chapters.

2.2.1 Customer Channelling

The process deals with customers arriving at the ECG Customer Service Centres with requests or concerns. The objective is to direct the customer to the correct person in charge to deal with the matter.

Dependent on the volumes and accessibility these functions could as well be integrated into a Field Service related Call Centre as well as with digital channels such as website (e.g. via a contact form) and mobile app. Table 8: Customer Channelling

Descriptor	Details
Process Name	Customer Channelling
Description	When a customer arrives at the Customer Service Centre, s/he can either have / report ▪ a problem / complaint or ▪ require a new electricity connection.
Goal	The objective of the process is to direct customers to the correct contact person to deal with the matter at hand

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Assumptions	The assumptions behind this process are that we are introducing a field service system, which records issues and advice and assists in the channelling of the customer to the appropriate contact person. Alternatively, we need to plan some type of Call Centre functionality into our process execution.

Interfaces	This process is the starting point of personal customer interaction within ECG.
Components	This process requires a Customer Relationship Management (CRM) component, plus (ideally) a Call Centre application connected to the ERP system. Alternatively, such application is going to be integrated into the ERP system itself. There are several ERP systems providing such functionality, alternatively there are various third-party applications, natively integrating into ERP system without further need to customise.
Data Sources	Information collected is by direct conversation with the customer, which is going to be entered into an appropriate application, which is then used as the process continues. It also serves as customer history.
Start Event (triggered by)	The processes triggered by a customer interaction at ECGs service points.

Inputs	Name	Source	Frequency	Volume	Media
	Customer Information	Interaction between commercial services officer and customer	Daily	Data still outstanding	Data should be entered into a CRM or call centre system
	Customer Complaint	Interaction between commercial services officer and customer	Daily	Data still outstanding	Data should be entered into a CRM or call centre system

Outputs	Name	Destination	Frequency	Volume	Media
	New customer master data for electricity connection	Application for new connection	Daily	Data still outstanding	▪ Routing workflow to connection team ▪ New Master Data
	Existing customer with master data for electricity connection	Application for new connection	Daily	Data still outstanding	▪ Routing workflow to connection team ▪ Updated Master Data
	Existing customer data	Customer complaint or technical issues	Daily	Data still outstanding	Routing workflow to technical team with scheduling of service order

Reporting	Reporting requirements include: ▪ Maintaining an activity log ▪ Status reports on ○ No. of application for new connection ○ No. technical problems encountered ○ Reason / type of technical problem encountered ○ workforce deployment reports ○ reaction time between opening and closure of request
Complexity	The complexity of the business process is low.
Organisational or Process Alignment	The introduction of a Call Centre technology combined with a Field Service / Workforce Management functionality would require some serious realignment and upgrade of the functionality and appropriate staffing. In addition, the technical teams also need to be adjusted.
Roles Involved	▪ Commercial services officer ▪ Supervisor of the technical teams plus ▪ technicians for either new connection or technical resolution

2.2.1.1 Flow Diagram Process – Customer Channelling

Figure 6: Flow Diagram: Customer Channelling
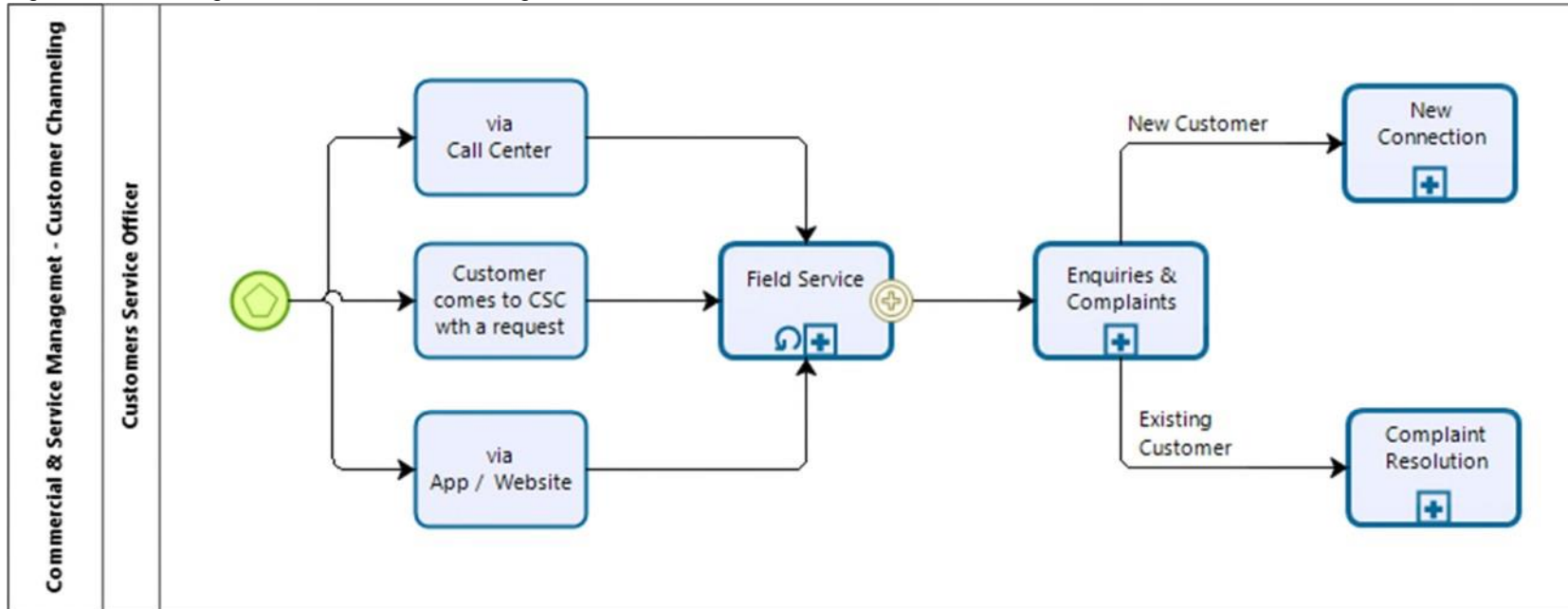
2.2.2   Enquiries & Complaints

Complaints can be either billing related or of a technical nature. Every action required is aiming at achieving customer satisfaction (which should be monitored). Complaints will be resolved either by the Field Service (to be established) or by the Financial Department(s).

Similar to personal customer channelling in CSC, the Call Centre channels customers to an appropriate contact point where concerns, problems or technical issues are handled. As mentioned above, it is planned to possibly introduce a Field Service & Workforce Management module (see point 2.1.3), which is dependent on the ERP System chosen.

In any event, a clear process and structure alignment are required as best practise and will upgrade the functionality / responsibility of both Call Centre and/or Field Service staff significantly. The finer details must be worked out when the ERP system is chosen.

Table 9: Enquiries & Complaints

Descriptor	Details
Process Name	Enquiries & Complaints
Description	The Enquiries & Complaints process describes how to manage customer requests, for example, ▪ customer complaints about malfunctioning electricity connections to their home ▪ area related complains, which not necessarily require to be a customer ▪ grievances, which are billing related complaints
Goal	The objective of the process is to act as first line of contact to the customer. The process has three main principle components. ▪ To report on general malfunctions and outages in a respective area, which are currently often reported to the control centre ▪ To manage customer complaints and deal with electricity faults in their individual homes ▪ To rectify billing related complaints
Assumptions	The service requires a functioning call centre or filed services technology, together with a countrywide service number and a routing possibility into the various areas.
Interfaces	▪ Basic connection to the SCADA system would be an advantage, but is not a prerequisite ▪ Interface required to the customer service ledger/master data of a customer

Components	The main components of the Field Service Centre should be:
	▪ Contact Management o Automatic Call Distribution (ACD) o Call Centre monitoring, analytics and performance o Call Recording
	    o Call Transfer and 3-Way Calling o Computer Telephony Integration (CTI)
	    o Workforce management ▪ Job Card or service order system
	▪ Access to material management
	▪ Access to the procurement module

Data Sources	The main source of information are the ▪ SCADA system for overall information about connectivity and potential outages ▪ Customer Ledger as a history system for individual customer complains ▪ Inventory ▪ Workforce scheduling and capacity
Start Event (triggered by)	Incoming call from the public or an individual customer
Inputs	The inputs are: ▪ Customer's account details ▪ Materials Management ▪ SCADA System ▪ ADMS (outage management system)

	Name	Source	Frequency	Volume	Media
	Customer Data	ERP via the finance department	Irregular	Irregular	Manual via incoming customer call
	Materials Management	ERP via the store's module	Irregular	Irregular	Material Stock levels
	Connectivity Data	SCADA system	Continuous	Big Data	On-screen data
	Connectivity Data	ADMS system	Continuous	Big Data	On-screen data
	Resolution Logging	From allocated units to solve the complaints	Continuous	Regular	Digital data via the connected modules

Outputs	The process outputs are:

- Information to the technical department to deal with complaints
- Reserved material for complaint handling
- Information of status on electricity availability or non-availability
- Purchase order in case of material unavailability

Name	Destination	Frequency	Volume	Media
Technical Problem	Workforce Management in Call Centre	Irregular	Irregular	Manual via Incoming customer call
Material Requirements	Technical Department for verification	Irregular	Irregular	Material Stock levels
Stock Transfer	Warehousing	Irregular	Irregular	Material transfer request
Material procurement	Procurement Department	Irregular	Irregular	Purchase Request
Service Management	Technical Department	Irregular	Irregular	Scheduling via Workforce management
Billing Complaints	Billing Correction in Finance Department	Irregular	Irregular	Invoice data from customer ledger

Reporting	The reporting requirements may include: ▪ Maintaining an activity log on complaint handling and reaction times ▪ Weekly status reports on: o Material availability reports o Technical reports on complaint resolution o Outage reports
Complexity	The complexity of the business process is low.
Organisational or Process Alignment	This process will be newly introduced and strengthened by combining it into a Field Service Component (see point 2.1.3). Therefore, organisational adjustments are to be expected in the commercial services department.
Roles Involved	▪ Customer Call Centre officer ▪ Technical manager in the area of concern ▪ Material manager ▪ Procurement officer

2.2.2.1 Flow Diagram Process – Enquiries & Complaints

Figure 7: Flow Diagram: Enquiries & Complaints
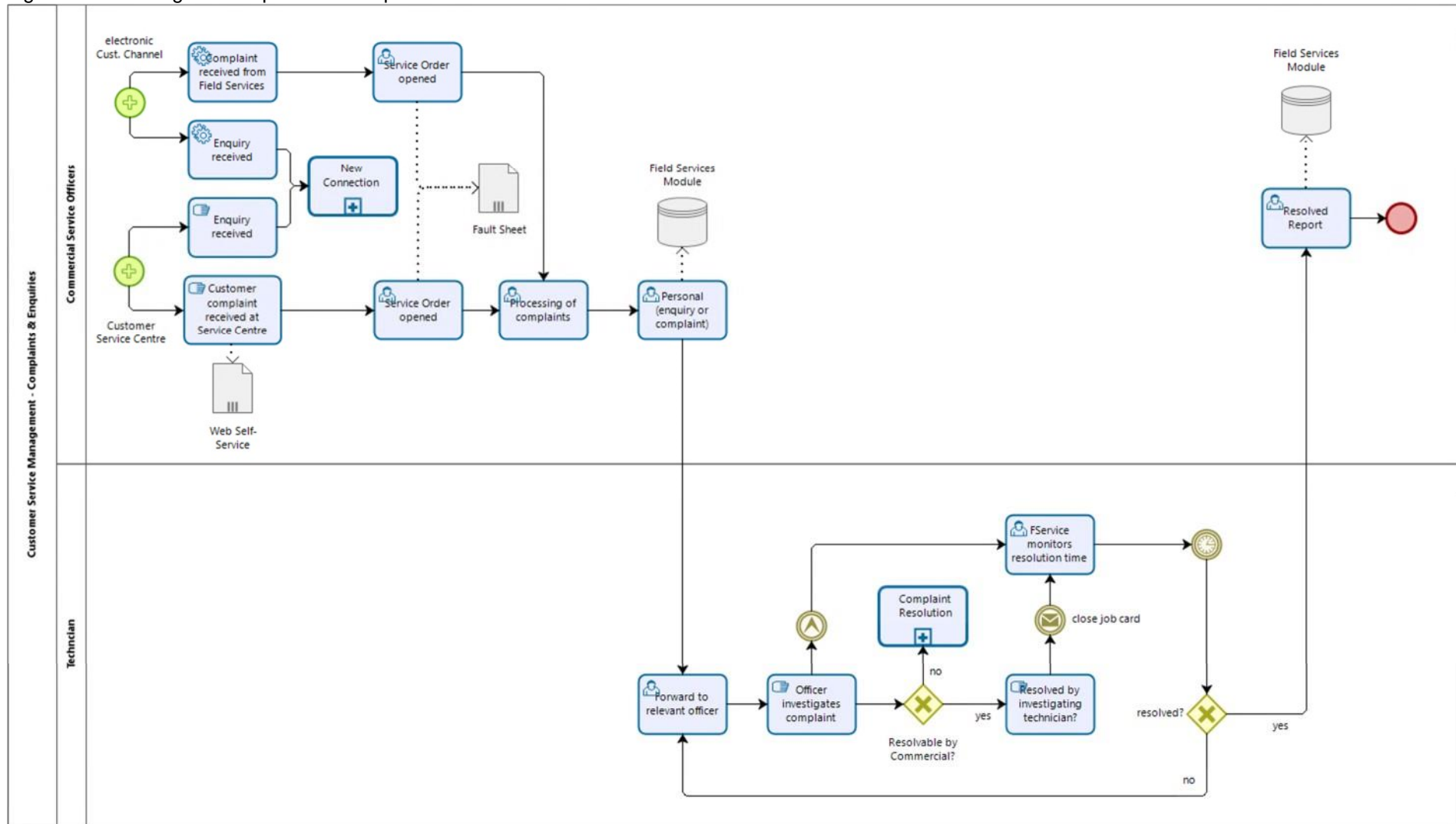
2.2.3   Complaint Resolution

Complaints can be either billing related or of a technical nature. Every action required is aiming at achieving customer satisfaction (which should be monitored). Technical complaints will be resolved by Field Service / Workforce Management (to be established, see 2.1.3) and billing related complaints by the financial department(s).

Table 10: Complaint Resolution

Descriptor	Details				
Process Name	Complaint Resolution				
Description	The Complaint Resolution process describes how to manage customer complaints, e.g., ▪ customer complaints about malfunctioning electricity supply ▪ customer complains about billing discrepancies The complaint resolution process is mainly a "manual' process dealing with physical job executions on site, rather than the ERP system.				
Goal	Complaint resolution ▪ on connectivity problems ▪ billing related issues				
Assumptions	The process works only with a fully functional Call Centre service module connected to the ▪ customer ledger and debtor's functionality ▪ Materials Management module ▪ Workforce management system for job cards				
Interfaces	No further interfaces required if the ERP System is utilised to its normal extend				
Components	No components other than the standard ERP system modules required				
Data Sources	ERP System				
Start Event (triggered by)	The incident management system records the logging of a problem to be resolved and allocates the required technical or financial unit.				
Inputs	**Name**	**Source**	**Frequency**	**Volume**	**Media**
	Complaint collocation	Call Centre	Regular	Continuous	Digital via ERP system
	Material Requirements	Customer com– plaint database	Regular	Continuous	Digital via ERP system
	Billing complaint	Call Centre	Regular	Continuous	Digital via ERP system
Outputs	**Name**	**Destination**	**Frequency**	**Volume**	**Media**
	Complaint routing	Routing of complaint to relevant unit for resolution	Regular	Continuous	Digital via ERP system or thirdparty app
	Material Allocation	Reservation / Ordering of material for the particular job	Regular	Continuous	Digital via ERP system or thirdparty app
	Billing Correction	Finance @ Customer Service Depart.	Regular	Continuous	Digital via ERP system
Reporting	The reporting is similar to the reporting of process 2.2.2 Enquiries & Complaints				
Complexity	Low				
Organisational or Process Alignment	A restructuring of technical response teams is required to increase the service levels, reduce reaction times and utilise the workforce efficiently. Additionally, this process will be partially integrated into a new Field Service / Workforce Management component (see point 2.1.3). Therefore, organisational adjustments are to be expected in the commercial services department.				
Roles Involved	▪ Call Centre officer ▪ Complaint resolution unit				

2.2.3.1 Flow Diagram Process – Complaint Resolution

Figure 8: Flow Diagram: Complaint Resolution
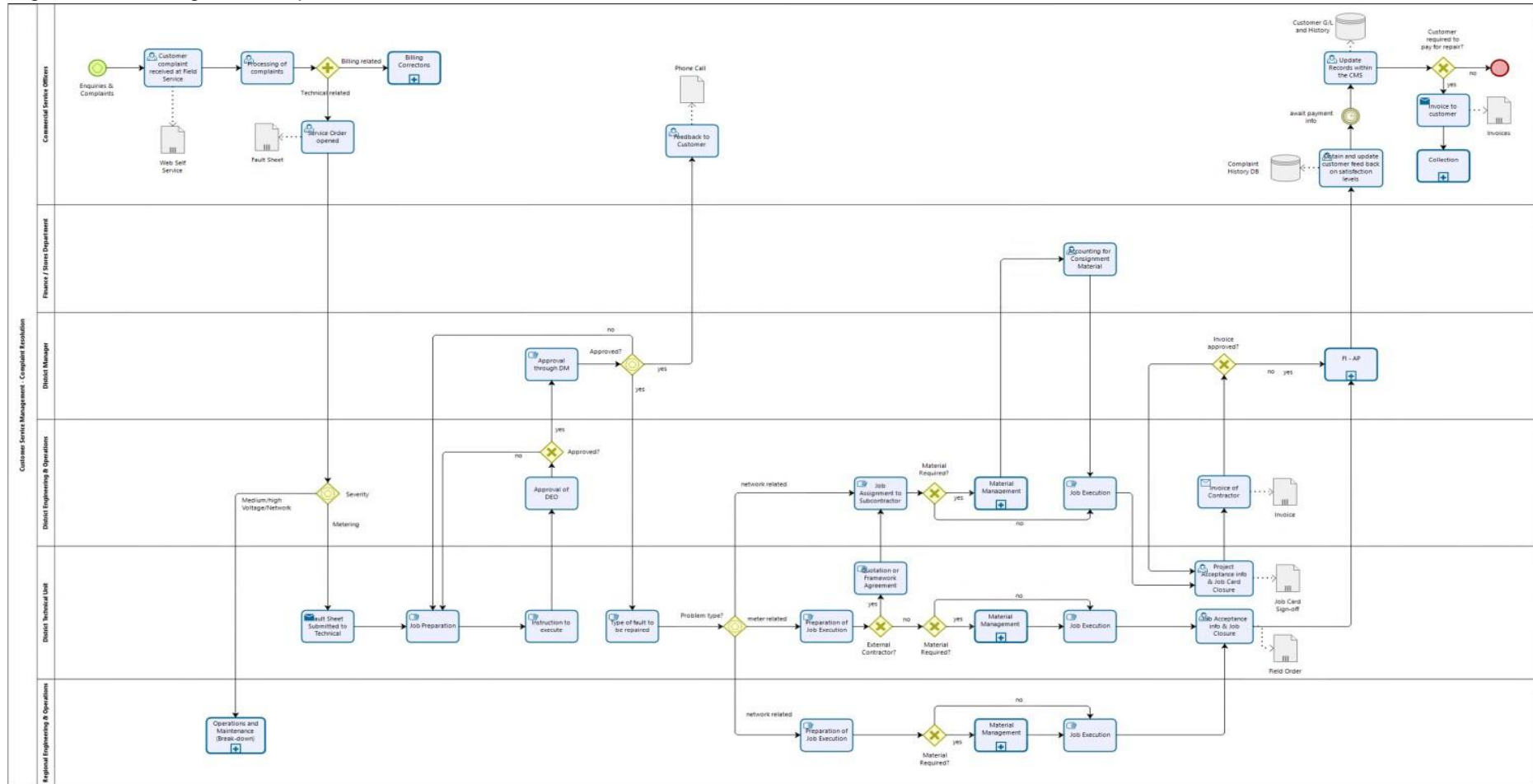
2.2.4 New Connection (Application)

The customer channelling process (see point 2.2.1) directs customers via several incoming options (personally at CSC, telephonically via the Field Services - Call Centre or electronically via website / app) to the contact point where the applications for new electricity connections are processed.

Table 11: New Connection (Application)

Descriptor	Details				
Process Name	New Connection (Application)				
Description	The New Connection process starts with checking the customer master data. In case of a new customer an application form has to be filled in by the customer or s/he's going to be helped by service personnel to fill in the form.				
	A debt check is executed. In case of existing debt, the process follows the collection route.				
	New customer needs to pay **a minimum connection fee (the amount is still to be determined and might be different for private households and businesses - but should be more than the current GHC10, is should be a proper free for minimum, connection charge).**				
	The customer can pay immediately (which is supposed to be the preferred option). Alternatively, the case is put on hold for 14 days to give the customer time to pay. Automatic payment check needs to be introduced.				
	In case the customer pays on time the process is routed to New Connection (execution), in case the customer does not pay within 14 days, s/he should be flagged, and the case is closed. The workflow suggests case closures.				
	It needs to be decided how to treat customers who failed to pay their minimum application fee in the time given.				
Goal	The objective of the process is to streamline the customer application procedures and to support the commercial officers in their endeavour to smoothly route the customers through the application process.				
	The goal also is to avoid minimal application fees to be accounted for but also to test the seriousness of the potential customer when it comes to application for electricity.				
Assumptions	The underlying principles of this process are:				
	▪ The customer is debt free with ECG.				
	▪ S/he / a business is serious about getting a connection by paying a reasonable application fee. ▪ There is no free electricity.				
Interfaces	The process interfaces with:				
	▪ Either natively included CRM module of the ERP system itself.				
	▪ Alternatively, via third-party CRM or call centre application.				
Components	The process is a component of:				
	▪ Customer master data				
	▪ The collection module				
	▪ A metre management system either integrated in the ERP or third-party application ▪ The workforce management system including job cards				
Data Sources	Directly sourced from the customer In future the ID No with address reference plus the GIS will form part of the data source.				
Start Event (triggered by)	The process is initiated by the customer channelling process to the correct commercial officer who guides the customer further along the process.				
Inputs	**Name**	**Source**	**Frequency**	**Volume**	**Media**
	Manual Application form	Customer data	Daily	Data still outstanding	Application form manual or alternatively online application (customer self-service)
	Existing Customer Application	Customer Master Data	Daily	Data still outstanding	Electronic form customer master data

		Setting and collection of standard application fee (still to be defined)	Predefined amount	Daily	Data still outstanding	Electronic invoicing ready to receive payment on the spot.	
Outputs		**Name**	**Destination**	**Frequency**	**Volume**	**Media**	
		Master data are filled for new customers	Workforce management and job card system	Daily	Data still outstanding	CRM or ERP System	
		Master data update for existing customers	Workforce management and job card system	Daily	Data still outstanding	CRM or ERP System	

Reporting	Reporting requirements include: ▪ Maintaining an activity log ▪ Status reports on o application for new connection o application fees paid, exception report o customer relation o reaction time between start and resolution o workforce deployment
Complexity	The complexity of the business process is low.
Organisational or Process Alignment	This process will be newly strengthened by partially linking it into a Field Service component (see point 2.1.2). Therefore, organisational adjustments are to be expected in the commercial services department.
Roles Involved	▪ Call Centre personnel ▪ Field Service personnel ▪ Customer for self-service ▪ Commercial officer in service centre

2.2.4.1 Flow Diagram Process – New Connection (Application)

Figure 9: Flow Diagram: New Connection (Application)
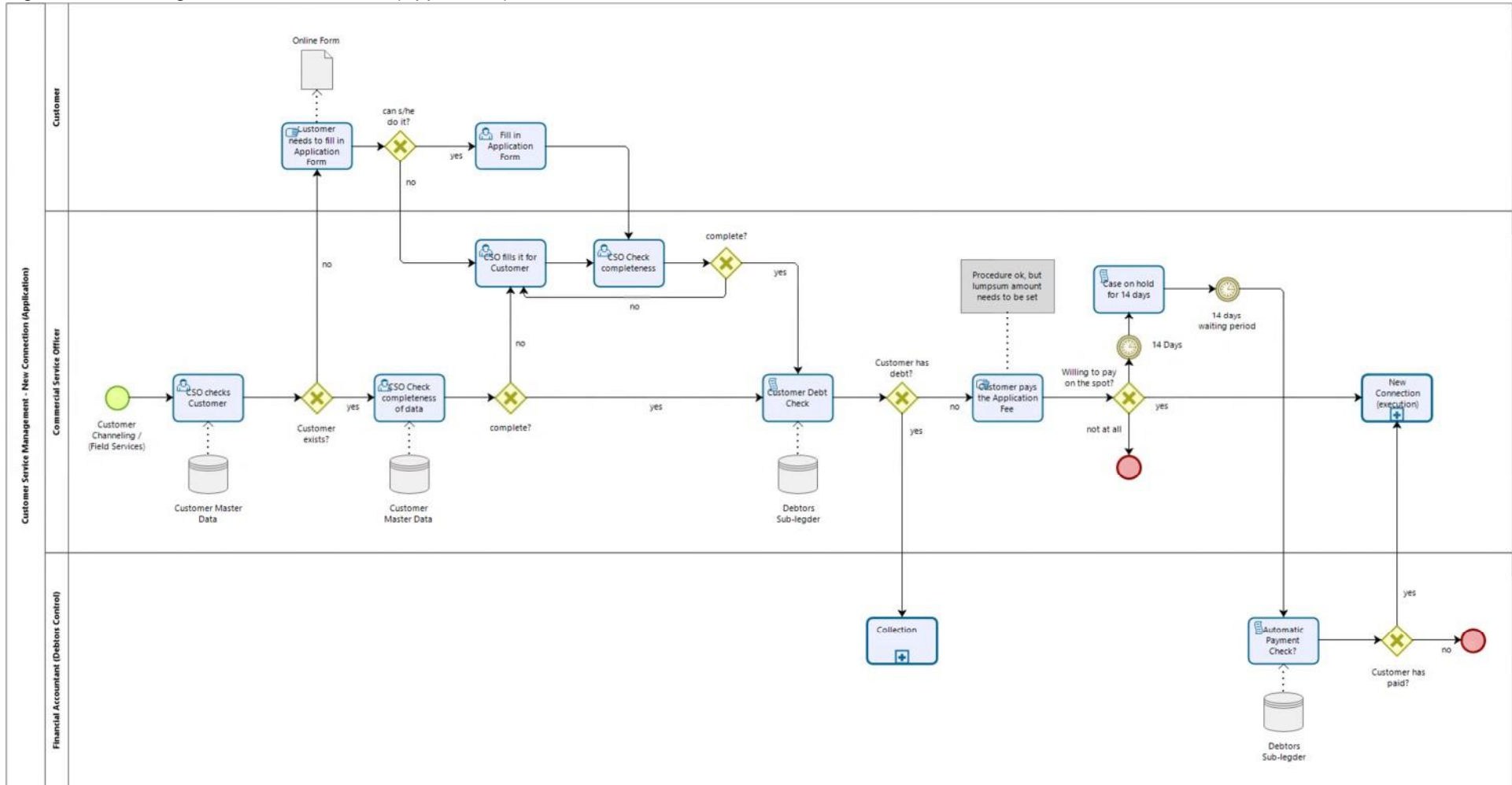
2.2.5   New Connection (Execution)

This process is mainly the technical process which handles the installation of new electricity connections. For the ERP system this process is in-so-far interesting as the service orders or job cards are processed here. In order to handle the service provider's invoice and the controlling requirements in Management Accounting the financial accounting processes are involved.

Table 12: New Connection (Execution)

Descriptor	Details
Process Name	New Connection (Execution)
Description	The process starts with a customer master data check and is followed by opening a job card to initiate the inspection and the estimation of the job to be done. The work is going to be scheduled as per workforce planning mechanisms.
Goal	The process consists of three steps: 1. The inspection process ensures that internal operations relating to the connection are executed according to specification and to check the material required to do the implementation, i.e. from switch board to house. 2. To add the job to an execution pending list to be incorporated into workforce management for further action. 3. To engage a sub-contractor in case the job does not fit into ECGs work schedule, which is a section that reporting will highlight in future.
Assumptions	The general assumption for this process is the successful establishment and proper vetting of the customer derived in section 2.2.4 New Connection (Application)
Interfaces	No external interface is required as long as section 2.2.4 New Connection (Application) is executed with the necessary diligence. This customer master data or the customer record in the ERP system will suffice as connecting link to be brought forward.
Components	The process is preceded by section 2.2.4 New Connection (Application)
Data Sources	Data are either derived from the: ▪ Customer master data as maintained in the customer ledger, or ▪ A newly opened customer record at the commercial services department
Start Event (triggered by)	The start event is the outcome and successful conclusion of section 2.2.4 New Connection (Application).
Inputs	The input are ▪ customer master data ▪ Workforce scheduling

	Name	Source	Frequency	Volume	Media

		Customer Master Data	section 2.2.4 New Connection (Application)	Dependent on the area / district where applications are done	Still unknown	Digital data in the ERP System
		Work schedule	Workflow management	As above	Still unknown	Digital data from the ERP System
Outputs		**Name**	**Destination**	**Frequency**	**Volume**	**Media**
		Job ready (Job Card closure)	Subcontractor invoice	Dependent on the area / district where applications are done	Still unbeknown	Digital ERP based
		Processing of subcontractor invoice	FI-AP	Dependent on the area / district where applications are done	Still unbeknown	Digital ERP based

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		FI-AP	Finance Section	Dependent on the area / district where applications are done	Still unbeknown	Digital ERP based	
Reporting	Reporting requirements include: ▪ Maintaining an activity log for Workforce management ▪ status reports on ○ installation of new connection ○ internal technical team performance ○ sub-contractor performance vs employment of own teams ○ reaction time between start and resolution ▪ workforce deployment						
Complexity	The complexity of the business process is low.						
Organisational or Process Alignment	This process will be strengthened by partially linking it into a Field Service / Workforce Management component (see point 2.1.3). Therefore, organisational adjustments are to be expected in the commercial services department.						
Roles Involved	▪ Commercial services officers in the districts ▪ District technical manager ▪ Technical team ▪ Sub-contractor						

2.2.5.1 Flow Diagram Process – New Connection (Execution)

Figure 10: Flow Diagram: New Connection (Execution)

2.2.6   Post-Paid Meter Reading

This process deals with estimation or reading of analogue electricity meters. The reading process as it stands has very little influence on the ERP system. But this will be a relic in future and be replaced by pre-paid- or smart meters.

We gained information about a meter management plus pre-paid revenue system to-be in the pipeline, which would influence the functional requirements of the ERP system. For Task 5 the functionality of these systems needs to be clarified and a way should be considered to eliminate post-paid customers, e.g. any defaulting customer is per definition converted into prepaid.

Table 13: Post-Paid Meter Reading

Descriptor	Details
Process Name	Post-Paid Meter Reading
Description	The process consists of three different sub-steps all aiming at collecting electricity unit information for billing: 1. Automated meter reading 2. Estimation of potentially used units (to be reconciled with) 3. On-site physical meter reading
Goal	The process aims at collecting the required data of electricity utilisation to enable ECG to invoice its customers.
Assumptions	The general assumption is that all customers are connected to the ERP System to be able to record unit data.
Interfaces	Basic data connection to the Meter Management System (MMS) provided by the chosen ERP (is dependent on the system chosen) or alternatively to a third-party application.
Components	Process is (will be) a component of: Meter Management and data collection system of the ERP
Data Sources	▪ Digital data delivered form the meter management system or alternatively from the manual data collected by the meter reader. ▪ Historic data from the customer ledger.
Start Event (triggered by)	The Start Event of meter reading is time based and triggered by the workforce management system schedule.

Inputs	Historic data as per data source of the customer ledger Meter reading data – digital – as delivered by the MMS Manual data as per monthly meter reading from the meter reader **(needs to be digitalised with third party or the ERP based Field Service application).**				
	Name	**Source**	**Frequency**	**Volume**	**Media**
	Workforce planning schedule	Workforce management system	Monthly	No. of post-paid customer per reading area	Digital data on Job Card system
	Historic customer data	Customer ledger	Monthly	No. of post-paid customer per reading area	Digital info from ERP System if and when required
	Meter reading data	Digital data as per MMS	Monthly	No. of post-paid customer per reading area	Digital data
	Manual electricity reading data	Meter reading on reading sheet (alternatively data digitalised)	Monthly	No. of post-paid customer per reading area	Manual data to be digitalised via 3rd party app
	Adjustment of Application fee				
Outputs	The output of the process is the reading data for customer invoicing.				

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	Name	**Destination**	**Frequency**	**Volume**	**Media**	
	Meter reading data	Accounts receivable for invoicing	Monthly	Customers of ECG	Digital data	
Reporting	The reports include e.g. the formal details of the • Consolidated monthly billing per defined area • Exception reporting of utilisation abnormalities • Activity reporting of reading performance					
Complexity	The complexity of the business process is medium.					
Organisational or Process Alignment	This process will be strengthened by linking it to the Field Service / Workforce Management component (see point 2.1.3). Therefore, organisational adjustments are to be expected in the commercial services department.					
Roles Involved	• Commercial services officers • Meter Readers • Financial accountants					

2.2.6.1   Flow Diagram Process – Post-Paid Meter Reading

Figure 11: Flow Diagram: Post-Paid Meter Reading
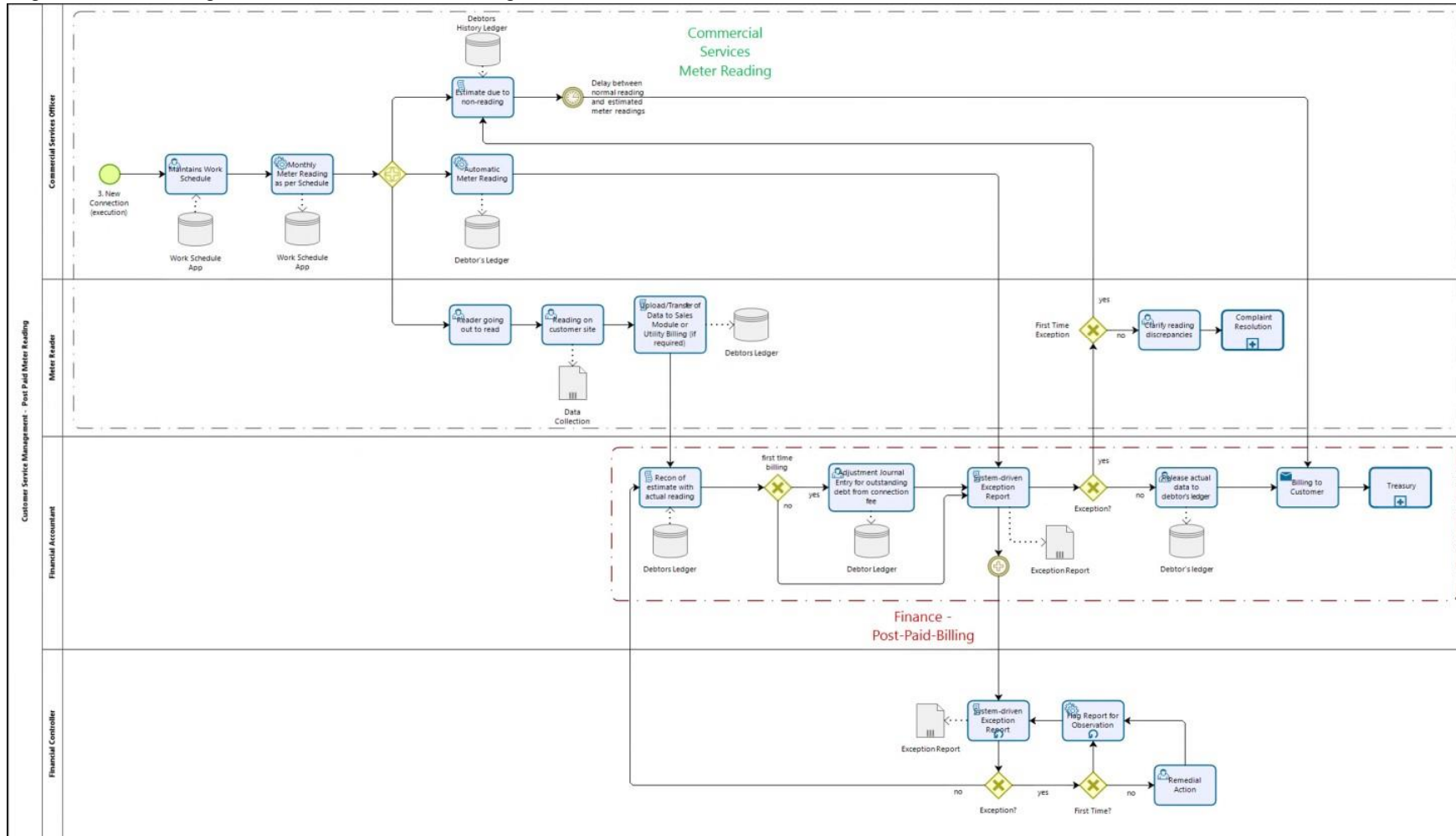
2.3 Financial Accounting

Financial accounting is the preparation and communication of financial information mainly for those outside of ECG, i.e. share- and stakeholders. Financial Accounting is therefore – similar to Management Accounting – more a recording and illustration exercise than a process related functionality and consists of four major components as listed below.

1) Income Statement

    1.1 Accounts Receivable

    1.2 Accounts Payable

    1.3 Profit or Loss

2) Balance Sheet

    2.1 Assets

    2.2 Liabilities

    2.3 Equity

3) Change in Equity

4) Cash Flow

From a process point of view, we will concentrate on the two main subjects:

▪ Accounts Receivable   ▪ Accounts Payable

which are described in the following paragraphs:

2.3.1 Annual Budgeting Process

This process is addressing the normal annual financial planning process which forms the basis of the formal variance analysis and consists of the following budget items:

- Income

- Operation Expenses ▪ Capital Expenses which are all included in one

  straight forward combined process diagram.

Table 14: Annual Budgeting Process

Descriptor	Details
Process Name	Annual Budgeting Process
Description	The process is the plan for ECGs operating and expenditures budget for a fiscal year by balancing the revenue or income with ECG's expenses.

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Goal	The annual budget lays out projected income and expenses for a 12-month period by expanding it to include a balance sheet and cash flow statement. It is the planning source of income and necessary expenses; assets, liabilities, and equity required to support operations. To achieve this objective the budgeting process combines the monetary requirements of each organisational unit within ECG.
Assumptions	▪ The main assumption is that in each organisational unit there is sufficient access to the ERP system to prepare an online budget to be submitted for approval according to the defined threshold levels. ▪ That the approving levels possess relevant knowledge and are integrated into the ERP workflow to release the budget. ▪ It needs to be decided if ECG follows a zero-based budget or a roll forward budget
Interfaces	None required, because expenses and revenues can be rolled forward from previous years
Components	The process consists of two main components: ▪ A roll forward expense budget ▪ A revenue budget on profit centre level
Data Sources	The process is fed by two sets of data: ▪ Meter reading data – historical ▪ Meter reading data - actual
Start Event (triggered by)	The process is triggered by the approaching financial year end budgeting period.
Inputs	<table><tr><th>Name</th><th>Source</th><th>Frequency</th><th>Volume</th><th>Media</th></tr><tr><td>Previous year's budget</td><td>General Ledger</td><td>Annual</td><td>Not relevant</td><td>Mainly manual records</td></tr></table>

	Infrastructure Budget	Premises / Estates or Engineering	Annual	Not relevant	Mainly manual records
Outputs	The process produces one budget set per organisational unit to be roll-up to ECG corporate level				
	Name	**Destination**	**Frequency**	**Volume**	**Media**
	Actual annual budget for the year ahead	General Ledger for financial figures	Annual	Not relevant	Digital records to be added to ERP
	Infrastructure budget	System Planning	Annual	Not relevant	Digital records to be added to ERP
	Planned Part of the budget for Plan/Actual comparison	General Ledge Management Accounting	Annual	Not relevant	Reporting function within the ERP
Reporting	The reports include e.g. the formal details of the ▪ The budget per organisational unit ▪ A budget comparison/exception report ▪ A consolidated ECG expense-revenue budget ▪ A consolidated balance sheet				
Complexity	The complexity of the business process is medium.				
Organisational or Process Alignment	No organisational alignment envisaged, as yet.				
Roles Involved	▪ Financial Accountant stationed at the organisational units ▪ Financial Controller per unit ▪ Financial Controller at Regional and HQ Level ▪ Approving management level				

2.3.1.1 Flow Diagram Process – Annual Budgeting

Figure 12: Flow Diagram: Annual Budgeting

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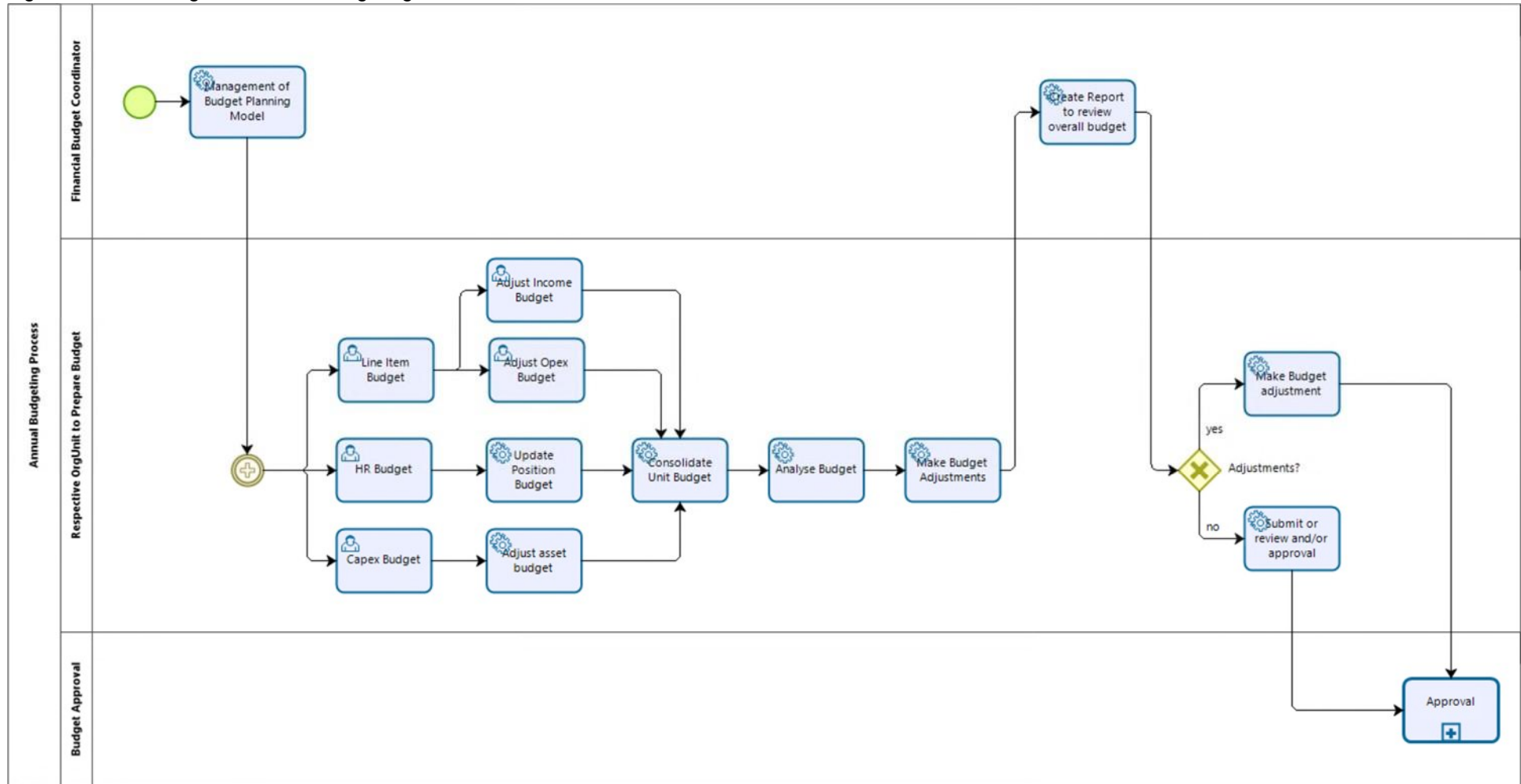
2.3.2   Accounts Receivable

Accounts receivable is the money that ECG has a right to receive because it provided its customers with electricity. There is always a risk that the full amount of the accounts receivable might not be collected or that monies are internally exposed. Hence, several processes are established to safeguard against such risks, which are in ECG's case in particular:

- Annual Budgeting Process

- Post-paid - Billing

- Treasury

- Collection

- Billing Correction

- Pre-paid Vendor Registration (as a general sub-process, see point 2.1.2)

- Accounting for pre-paid Payment

These processes have been simplified to fit a prospective ERP system and are described below.

2.3.2.1   Post-paid – Billing

The Post-paid - Billing process takes over from the Post-Paid Meter Reading process and handles the billing and collection part of ECG's electricity sales.

Table 15: Post-Paid - Billing

Descriptor	Details
Process Name	Post-paid - Billing
Description	The process is the second half of the post-paid process. The commercial services section is responsible for the technical part of the post-paid billing process and handles part 1, the reading process. The second half deals with the mere billing process itself; which is passed on from Commercial Service Management (Field Service) to the Finance Department.
Goal	Finance is to take over the billing sequence from Commercial Service Management (CSM) to continue with all money related tasks. At the takeover point the CSM needs to host a financial accountant who reports to the Finance Department.
Assumptions	Underlying principles of this process are that the CSM department is fully equipped and responsible to maintain all electricity reading related functions. CSM in this scenario is responsible to update and maintain all electricity readings, while the Finance Department deals with all billing related activities commencing after the metre reading is concluded. Billing is done on a daily basis according to the customer's reading cycle.
Interfaces	Interfaces are only required to automated meters.
Components	The process consists of two main components: 1. A compliance check, reconciling previous readings with actual readings indicating if parameters are consistent with historical readings. 2. The actual billing of the customer.
Data Sources	The process is fed by two sets of data: - Meter reading data - historical - Meter reading data - actual
Start Event (triggered by)	The process is triggered by the monthly meter reading.

Inputs	The process requires two set of data: ▪ Historic Meter Reading Data ▪ Manual Meter Reading Data					
	Name	**Source**	**Frequency**	**Volume**	**Media**	
	Meter Reading History	Debtor's Ledger	Monthly	No of post-paid customer	Digital records	
	Meter Reading Data	Manual Meter Reading Data	Monthly	No of post-paid customer	Third party App	
Outputs	The process produces one set of new data per customer every month: ▪ Manual Meter Reading Data					
	Name	**Destination**	**Frequency**	**Volume**	**Media**	
	Meter Reading Data	Customer Billing	Monthly	No of post-paid customer	Third party App	
Reporting	The reports include e.g. the formal details of the ▪ Consolidated monthly billing per defined area ▪ Electricity usage report ▪ Exception reporting on billing abnormalities					
Complexity	Medium					
Organisational or Process Alignment	Due the separation of technical and financial tasks in the commercial service department some minor organisational adjustments might be required, e.g. financial accountants attached to the CSC.					
Roles Involved	▪ Customer Service officer for workforce scheduling ▪ Meter Readers ▪ Financial Accountant stationed at the customer service centres ▪ Financial Controller					

2.3.2.2   Flow Diagram Process – Post-paid - Billing

Figure 13: Flow Diagram: Post-paid - Billing
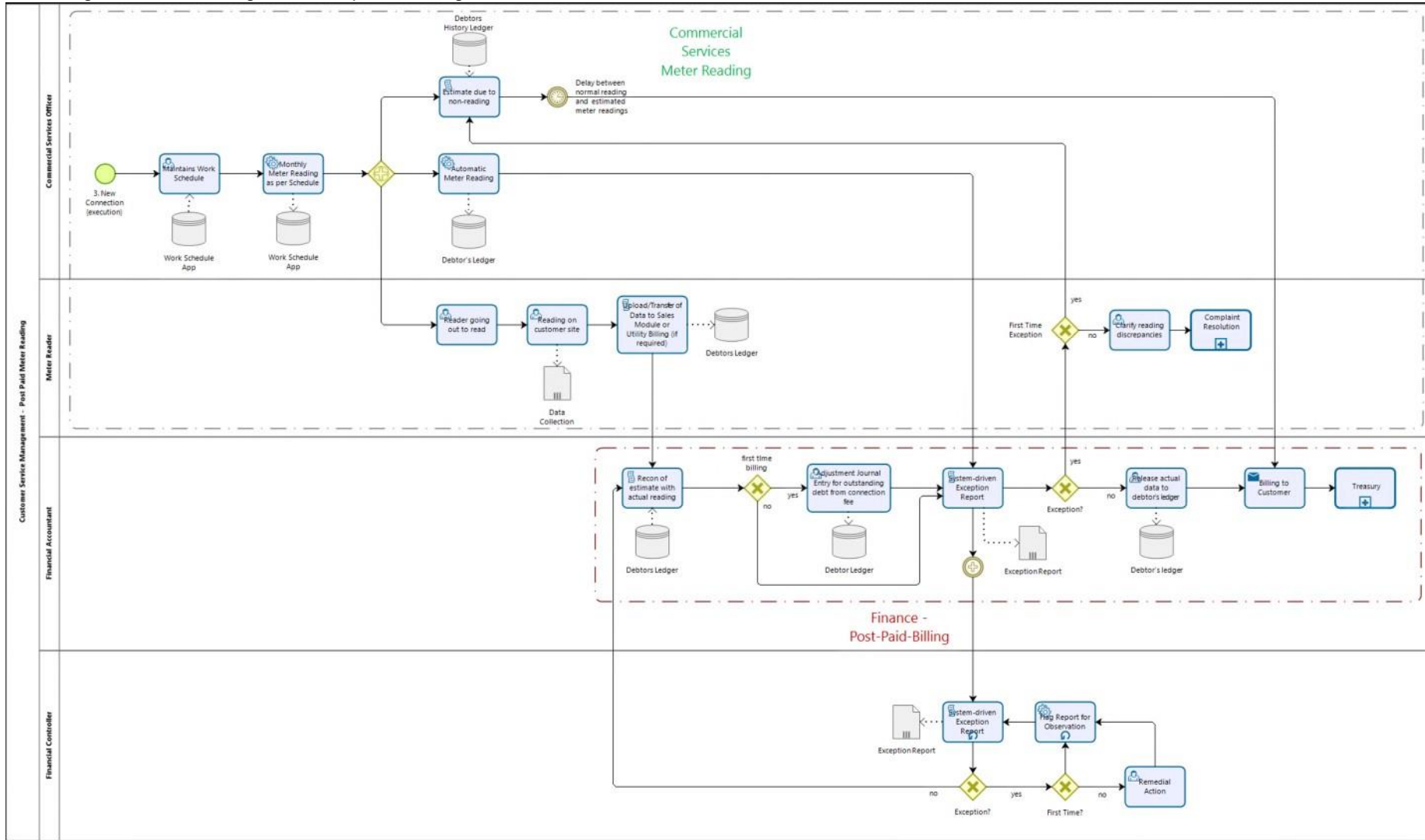
2.3.2.3 Treasury

The treasury process monitors via bank statements any type of payments received by ECG in terms of its electricity sales and provides the defaulting information further on the collection process.

Table 16: Treasury

Descriptor	Details				
Process Name	Treasury				
Description	The Treasury process is an integral part of the post-paid billing process combined with the Collection process. It deals with collecting and accounting for customer receipt on a daily basis.				
Goal	The treasury process receives and accounts for monies received from customers as they are paying it into bank accounts or cash or via cheque.				
Assumptions	The process depends on solid information produced by the meter reading procedures and are entered correctly and are verified in form on the incorporated exception reporting. Information is been provided by the billing module as described in point 2.2.6 Post-Paid Meter Reading which is integrated into the ERP System.				
Interfaces	No interfaces required, all information can be available in the ERP System, if set up correctly without any interference from third-party applications.				
Components	The process is a component of the monthly billing process.				
Data Sources	Data are provided via the ERP System.				
Start Event (triggered by)	The process is triggered automatically as soon as a billing cycle is been initiated.				
Inputs	Typical inputs include: the monthly bills per customer as well as monies received records				
	Name	**Source**	**Frequency**	**Volume**	**Media**
	Post-Paid Billing	Incoming billing data	daily	No. of customers	Digital data from banking system
Outputs	During the treasury process all incoming payments are allocated to customer's debt on a daily basis.				
	Name	**Destination**	**Frequency**	**Volume**	**Media**
	Payment receipt	Treasury Function recording and allocating incoming payment	daily	No. of customers	Digital data from CRM System
	Bank Statements	Collection	Daily	No of customers	Digital data from banking system
Reporting	The reporting requirements for this process should include as a minimum: ▪ Statement of receipts on the treasury accounts ▪ Bank account reconciliation with post-paid -billing ▪ Daily payment reports by area				
Complexity	Low				
Organisational or Process Alignment	An in-depth look at treasury is required to assess the organisational implications if the present treasury functionality is or should be brought closer to the finance section handling the billing and collection. It is -at first glance- unusual that the responsibility is artificially segregated. The treasury functionality is in most - best practise - cases slightly different, but not necessarily operative.				
Roles Involved	Treasury officers allocated to financial accounting.				

2.3.2.4 Flow Diagram Process – Treasury

Figure 14: Flow Diagram: Treasury
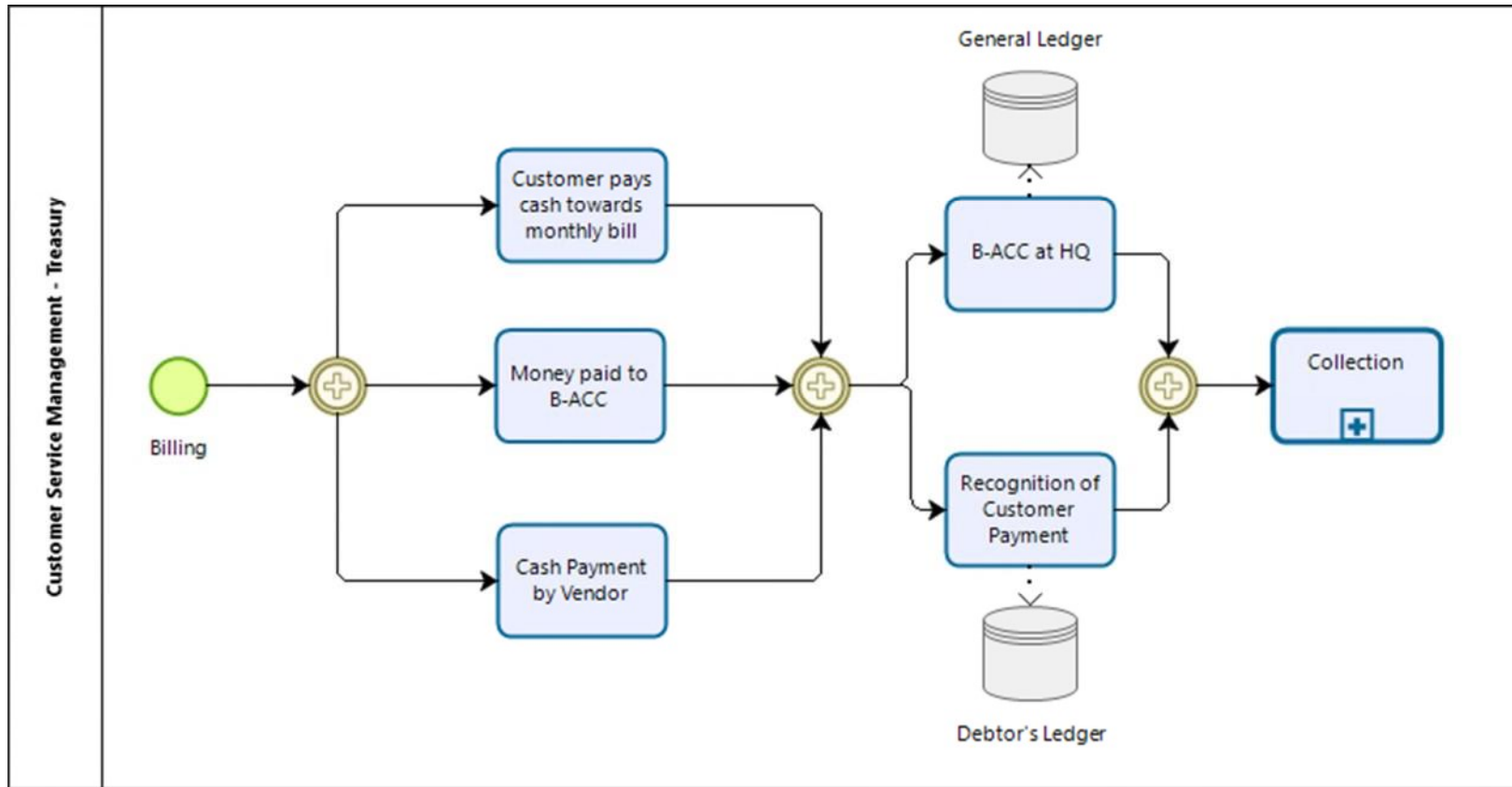
2.3.2.5 Collection

Based on the information provided by treasury the finance department handles the day-to-day reconciliations of incoming customer payments and takes appropriate measures in case of nonpayments by initiating disconnections and if required legal actions.

Table 17: Collection

Descriptor	Details
Process Name	Collection
Description	The process deals with collecting and accounting for customer receipt on a daily basis. Secondly dunning and enforcing payment through disconnection procedures.
Goal	▪ Account for monies received from customers and to remind customer in case payments are not received on time or bills are not settled correctly. ▪ Apply dunning procedures ▪ Arrangement with customer to pay off outstanding debt ▪ Enforce payment by disconnecting customers ▪ Initiate legal proceedings in case of long-term non-payment
Assumptions	The process depends on solid information produced by the meter reading procedures and are entered correctly and are verified in form on the incorporated exception reporting. Information is been provided by the Treasury module which is integrated into the ERP System (see point 2.3.2.3).
Interfaces	No interfaces required, all information can be available in the ERP System, if set up correctly without any interference from third-party applications.
Components	The process is a component of the monthly billing process.
Data Sources	Data are provided via the ERP System.
Start Event (triggered by)	The process is triggered automatically as soon as a billing cycle is been initiated.
Inputs	Typical inputs include: the monthly bills per customer as well as monies received records | Name	Source	Frequency	Volume	Media
---	---	---	---	---
Treasury Function	Incoming payment data	daily	No. of customers	Digital data from banking system	
Outputs	Identify the outputs and identify all external products to be prepared after performing the process. Examples of outputs include: products, services, reports, information, and paperwork. For example: ▪ Audit Report ▪ Security Report ▪ Non-compliance events | Name	Destination	Frequency	Volume	Media
---	---	---	---	---
Payment receipt	Treasury Function recording and allocating incoming payment	daily	No. of customers	Digital data from CRM System
Dunning Procedures	Outstanding payment information derived from daily payment recon	daily	No. of customers with outstanding payments	Digital data from Finance System
Payment Arrangements	Outstanding payment information derived from dunning procedures	daily	No. of customers with outstanding payments	Digital data from Finance System	

| | Disconnection Procedures | Outstanding payment information derived from daily payment recon | daily | No. of customers with outstanding payments | Digital data from Finance System |
| | Works Order | Workforce management system | daily | No. of customers with outstanding payments more than 44 day plus unsuccessful dunning | Digital data from Finance System |

Reporting	The reporting requirements for this process should include as a minimum: ▪ Daily payment reports ▪ Aged Accounts Receivable Report ▪ A report on outstanding payments per area ▪ Dunning procedures applied by area ▪ Recon of payment arrangements agreed with customers and its fulfilment ▪ Workforce allocation for disconnection ▪ Workforce performance and reaction times ▪ Outstanding legal proceedings
Complexity	Low
Organisational or Process Alignment	No alignments required.
Roles Involved	Treasury allocated to commercial services, financial accounting, technical teams

2.3.2.6 Flow Diagram Process – Collection

Figure 15: Flow Diagram: Collection
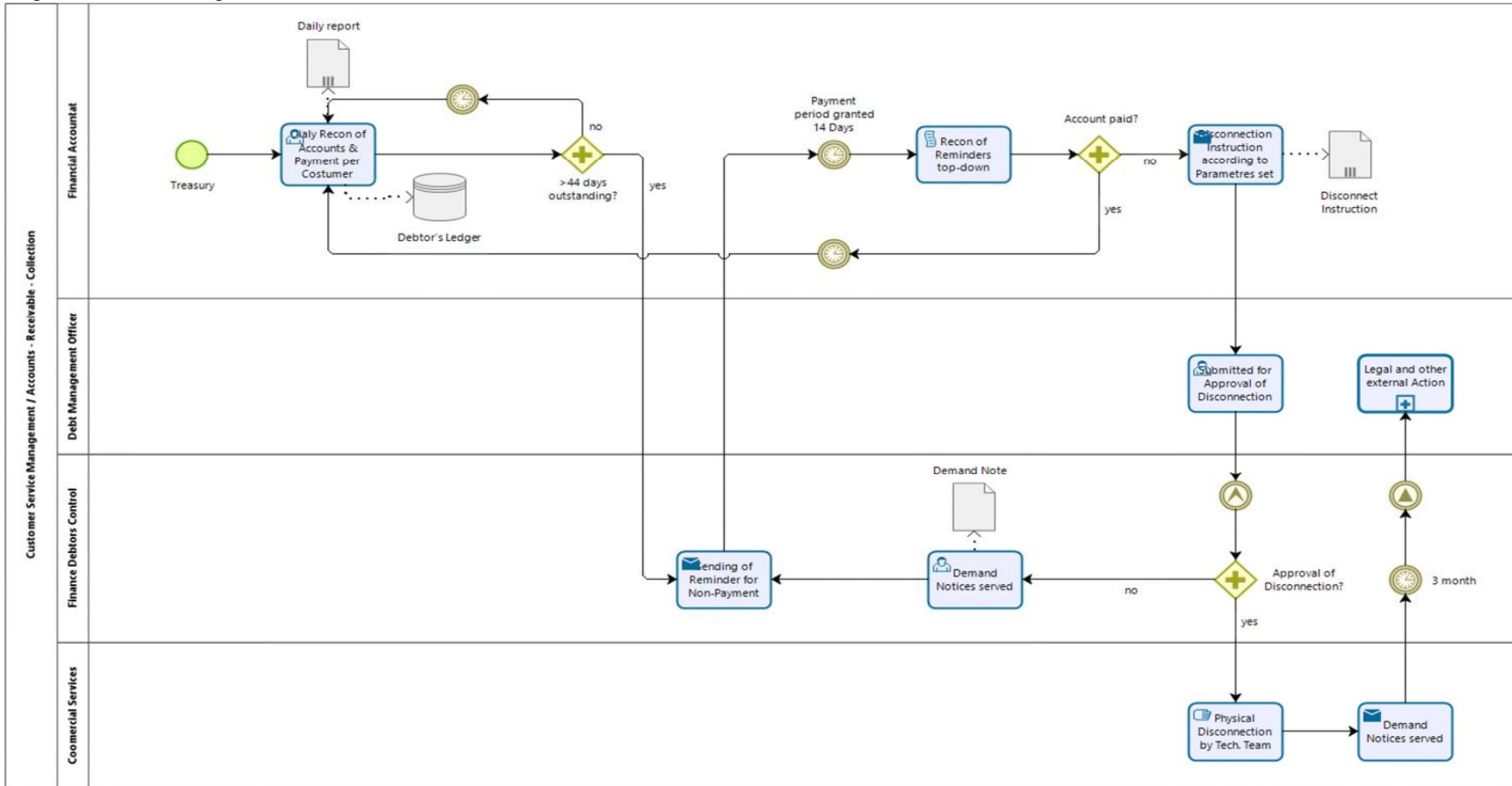
2.3.2.7   Billing Correction

The process Billing Correction allows customers to question their invoices received from ECG and initiate an investigation into possible faults.

The process as such, is currently subdivided between two departments and in our approach, we attempted to standardise and combine various process tasks wherever possible without eliminating the various areas of responsibility.

Table 18: Billing Correction

Descriptor	Details				
Process Name	Billing Correction				
Description	The process deals with two components: ▪ Technically related questions, which lead to possible false invoicing, ▪ Mere invoice and accounting related questions about payments, receipts or false postings. In all instances, an investigation will take place, which is either led by Service Management or alternatively by the allocated financial accountant.				
Goal	The objective of the process is to rectify any type of incorrect invoicing, payments or alike.				
Assumptions	The assumptions are that we are going to have a properly structured Call Centre mechanism as well as Customer Service Centre where customers can personally walk in and raise their complaints.				
Interfaces	Process interfaces with the Customers': ▪ Master data ▪ Electricity reading history ▪ Invoice and payment history				
Components	The process is part of the overall Accounts Receivable processes.				
Data Sources	Data sources are mainly coming from the customer ledger and the store transaction data.				
Start Event (triggered by)	Process is triggered by customer either raising a complaint via the Call Centre or alternative as a walk-in client at a Customer Service Centre.				
Inputs	Typical inputs include: monthly bills per customer as well as monies received records				
	Name	**Source**	**Frequency**	**Volume**	**Media**
	Meter Reading	Customer Ledger transaction data	irregular	irregular	Digital from the ERP System

	Invoice information	Customer Ledger transaction data	irregular	irregular	Digital from the ERP System

Outputs	The process produces the following outputs, which are mainly kept in the ERP System and updated customer ledger: ▪ Customer Ledger transaction data to correct meter reading data ▪ A/Receivable Journals to be posted in case of corrections ▪ CRM System to keep the customer informed about decision point				
	Name	**Destination**	**Frequency**	**Volume**	**Media**
	Corrected Meter Reading	Customer Ledger transaction data	irregular	irregular	Digital from the ERP System
	Corrected Invoice (Journal)	A/Receivable	irregular	irregular	Digital from the ERP System
	Customer Information	CRM System	irregular	irregular	Digital from the ERP System
Reporting	The process will require the following reports: ▪ Transaction log off time and person receiving the call ▪ Reaction time ▪ Resolution time ▪ Workforce deployed (if any)				

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	▪ Location information (where does it happen)
Complexity	Medium
Organisational or Process Alignment	Organisational adjustments are required to integrate this process into a properly designed Field Service (see point 2.1.3).
Roles Involved	▪ Service or Call Centre staff ▪ Meter Reading staff in the affected areas ▪ Financial Accounting centrally attached to Service Management

2.3.2.8 Flow Diagram Process – Billing Correction

Figure 16: Flow Diagram: Billing Correction
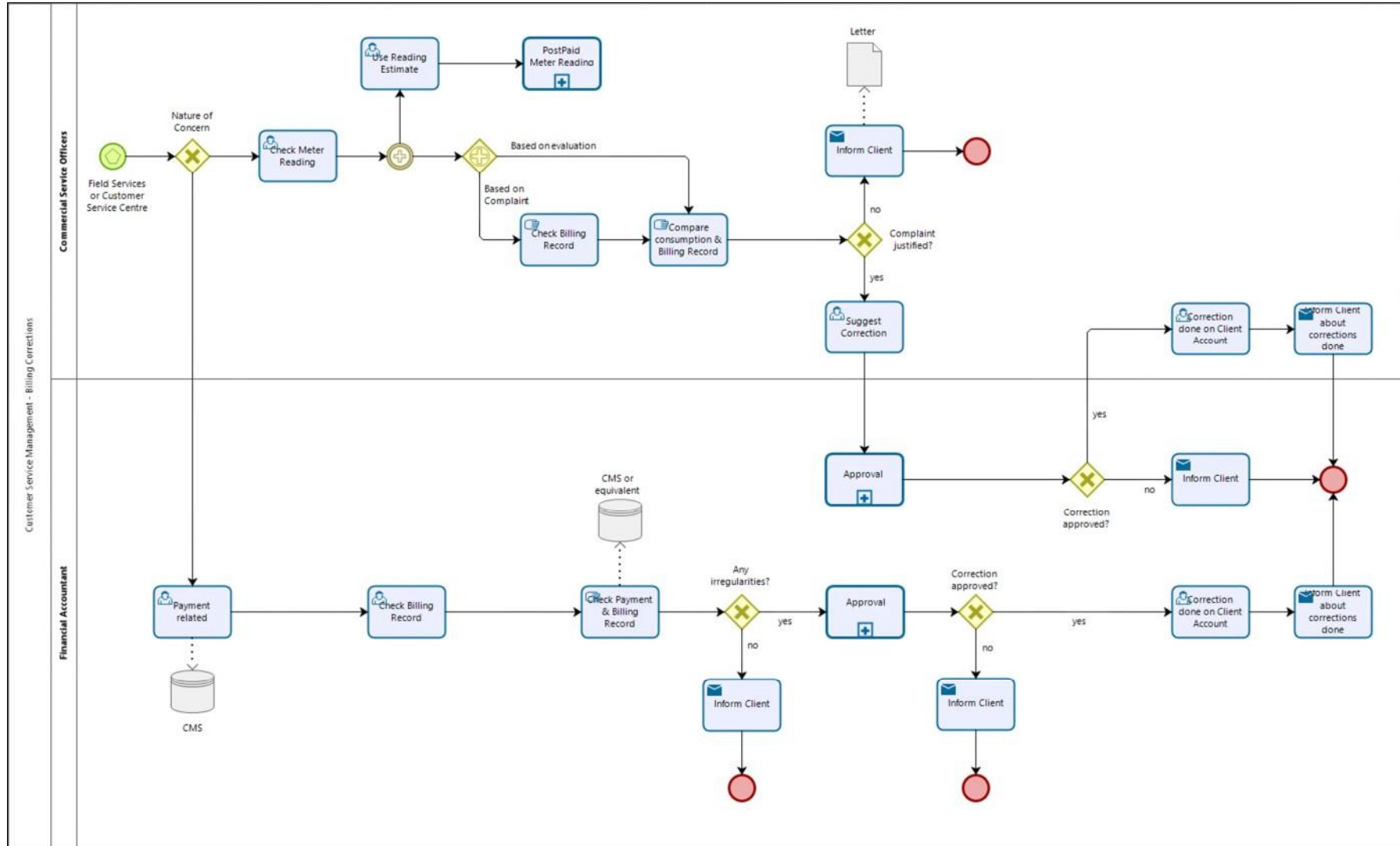
2.3.2.9   Pre-paid Vendor Registration

This process has been consolidated into one generic subprocess combining and streamlining the registration and approval of any type of supplier of goods and services, contractors as well as pre-paid vendors who wish to do business with ECG under the same harmonised conditions.

This process pertains to

- Supplier/Vendor Registration
- Pre-paid Vendor Registration
- Registration of Contractors

For more details see point 2.1.2 Vendor Registration.

2.3.2.10 Accounting for pre-paid Payment

The Accounting for pre-paid Payment is a reasonable straight forward process because electricity units for resale are only done on advance payment. There is no sales of credit foreseen.

In straight terms that means no cash – no units.

Table 19: Accounting for pre-paid Payments

Descriptor	Details
Process Name	Accounting for pre-paid Payment
Description	A registered pre-payment vendor buys bulk electricity for on-sale to private customers.
Goal	The objective of the process is ▪ To load electricity units to the vendor's sales-engine, collect the monies for it and allow the vendor to on-sell to individual costumers ▪ To reconcile the units bought versus the units sold ▪ To unify the vending systems in order to avoid the multitude of different interfaces to be established ▪ To generate one stable vending platform

Assumptions	▪ The vendor is a recognised and registered vendor ▪ And has a recognised vendor engine at his disposal
Interfaces	▪ An interface is required between the (various) vending system(s) in use and ECG's billing system ▪ Process interfaces with: Treasury
Components	The process requires two components: ▪ A billing engine on ECG's side ▪ A vending system on the vendor's side
Data Sources	The billing engine converts the electricity units into numeric units to be sold.
Start Event (triggered by)	The vendor to buy electricity for resales from ECG
Inputs	The process requires numeric electricity units to be converted into sellable units

Name	Source	Frequency	Volume	Media	
Electricity units	ECG grid	Daily	Not known	Numeric units	

Outputs	The process produces units to be sold to customers and the reporting of such transactions.

	Name	Source	Frequency	Volume	Media	
	Electricity units for resale	Converted electric unit form ECG grid	Daily	Not known	Numeric units	

Reporting	The process should include sales reports indicating amongst others: ▪ Units sold from ECG to vendor ▪ Units sold from Vendor to customers ▪ Timeframe and volumes of such sales ▪ Recharge reports – units and amounts ▪ Cash flow forecast per vendor ▪ Cash flow consolidated by area ▪ Units being returned to ECG The more complex way of report – with similar results – is to measure customer consumption via the meter daily and reconcile it with the number of units purchased. This results in a higher degree of accuracy with however similar reporting functionalities and results.
Complexity	Low
Organisational or Process Alignment	The process has been simplified and therefore some organisational adjustments are required.
Roles Involved	ECG Sales point, alternatively bank deposit, Vendor

2.3.2.11 Flow Diagram Process – Accounting for pre-paid Payment

Figure 17: Flow Diagram: Accounting for pre-paid Payment

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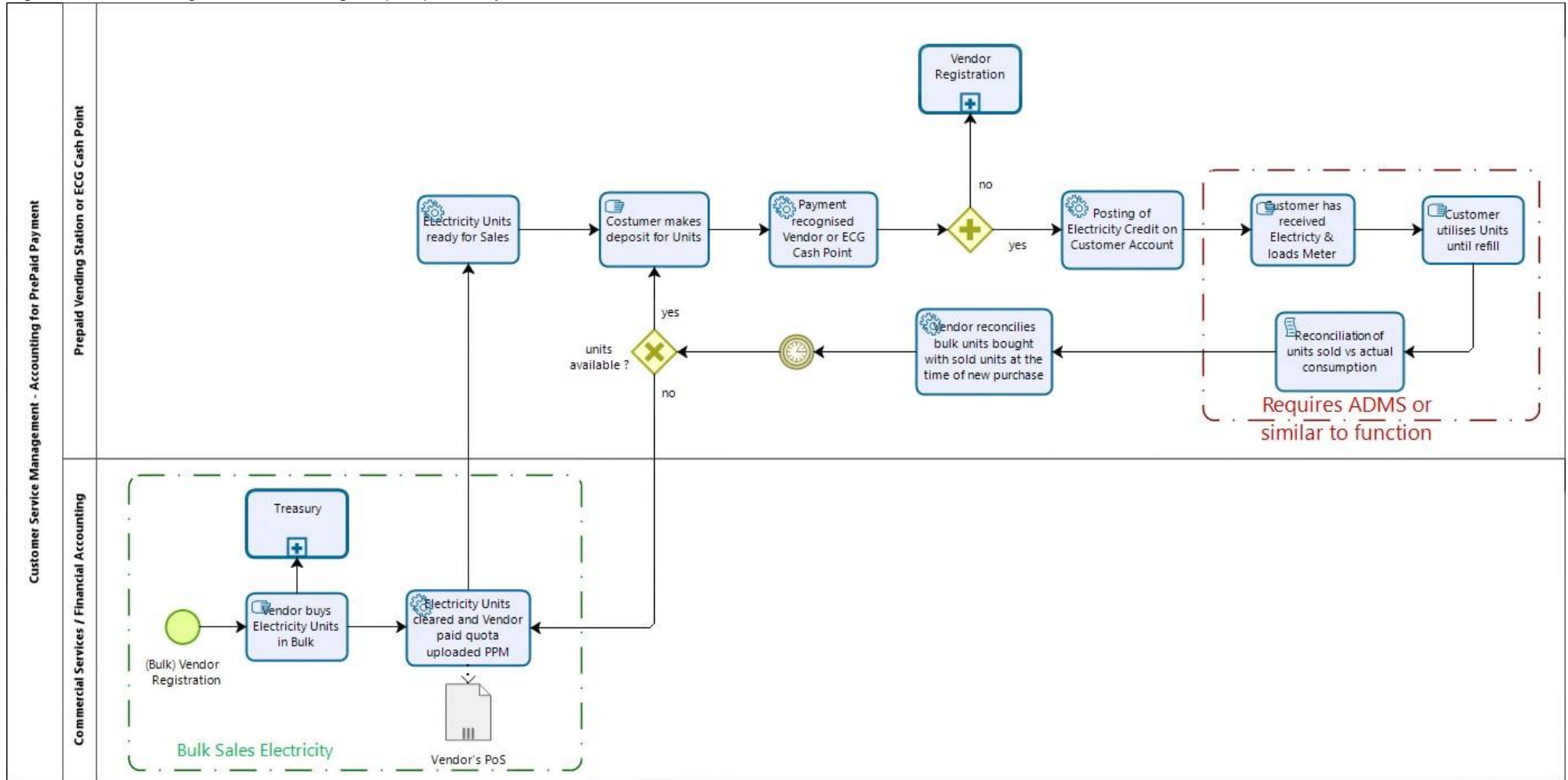
2.3.3   Accounts Payable

The Accounts Payable process has been significantly simplified into one single process by integrating it into a best practice standard ERP workflow dealing with requisitions up to receiving and payments for goods and services.

Table 20: Accounts Payable

Descriptor	Details				
Process Name	Accounts Payable				
Description	The process describes the settlement of invoices on any nature.				
Goal	The objective of the process is to synchronise all payment for goods, service and consumable into one single process.				
Assumptions	ECG used to use different ways of payments and processes to achieve the same results, i.e. to pay a supplier for a submitted invoice. The general assumption behind the accounts payable process is that vendors have submitted an invoice for any type of goods, services, consumable or assets, which needs to be paid on time. The approval level to release payments are dependent on: 1. The nature of supplies delivered 2. The value of the invoice These two questions are the categorising issues to be recognised and dealt with.				
Interfaces	None required, because the invoice needs to be manually verified and allocated to a Purchase Order. Both is handled with the ERP System.				
Components	The process consists of: 1. Purchase requisitions raised by end-users 2. Approved purchase orders 3. A recognised and verified Goods Received Note (GRN) and Service Received Note (SRN) 4. A vendor invoice to be paid 5. Several steps of approval dependent on the thresholds for payment releases as per 4-eye principle				
Data Sources	Purchase information via the ERP system				
Start Event (triggered by)	Incoming invoice to be paid				
Inputs	The process consists of four possible inputs:				
	Name	**Source**	**Frequency**	**Volume**	**Media**
	Purchase Order	ERP System via procurement process	Daily	Data still outstanding	ERP information
	GRN	Materials Management Process	Daily	Data still outstanding	ERP information
	SRN	As-build Process or hand-over certificate	Daily	Data still outstanding	ERP information
	Vendor invoice	External	Daily	Data still outstanding	ERP information
Outputs	The process has one output only:				
	Name	**Destination**	**Frequency**	**Volume**	**Media**
	Verified invoice, cleared for payment	Bank for payment	Daily	Data still outstanding	ERP information

Reporting	The reporting requirements associated with the accounts payable process should include: ▪ Maintaining an activity log
	▪ Bank Account Reports
	▪ Invoices Paid Reports
	▪ Vendor Reconciliation report (outstanding vs paid)
	▪ Aged Accounts Payable Report
	▪ Cash Requirements Report

	▪ Credit Memo Report
	▪ Hold Payment Report
	▪ Invoice Expense Allocation Report just to name the basic reports.
Complexity	The complexity of the business process is medium.
Organisational or Process Alignment	Some organisational adjustments should be expected when consolidating the payment functions into a more centralised function.
	Districts and regions will need to be looked at, because the ERP system eliminates any border or obstacles to communication.
Roles Involved	Accounts Payable Staff in HQ

2.3.3.1   Flow Diagram Process – Accounts Payable

Figure 18: Flow Diagram: Accounts Payable
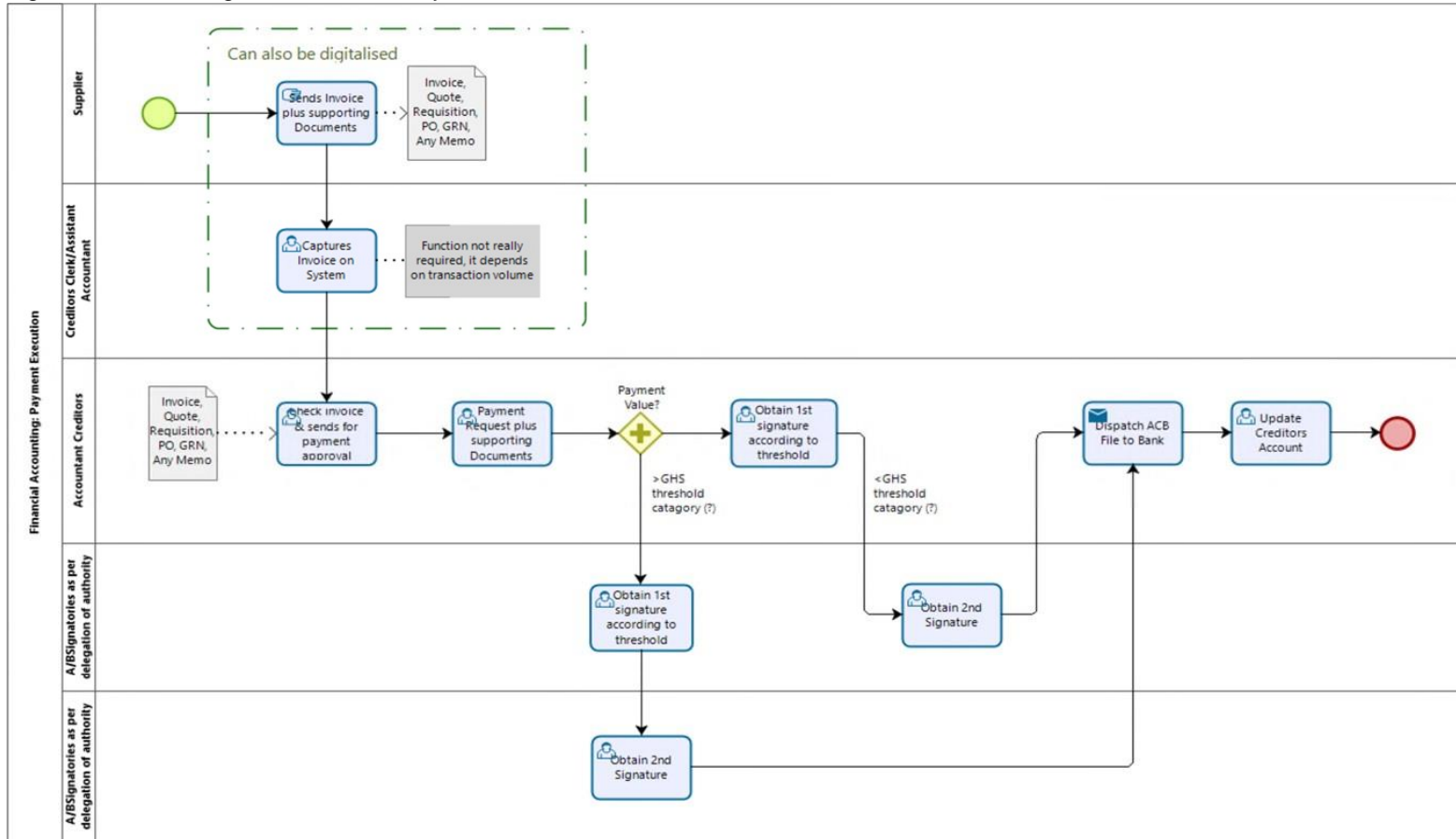
2.4   Management Accounting

Management Accounting is an in-house function that includes the recording and reporting of an organisation's financial transactions and then converting it to financial and non-financial indicators for management decision making. It is not a process as such; therefore no process diagram can be included here.

Its purpose is to highlight work contents, structures, purposes, accuracies, users to provide information about the performance of departments, managers and operating units, including but not limited to resource utilisation in terms of people, equipment, material and financial resources. Given that fact, Management Accounting is tailored to meet the management needs of an organisation and is therefore much broader in scope than financial- or cost accounting.

Organisations with strong hierarchical control are more than anybody else required to deliver regular information to their managers for purposes of monitoring and control, in order to help them reaching the organisation's key performance indicators (KPIs). Finally, both departmental and employee performance can be regularly evaluated and eventually rewarded based on information supplied by the Management Accounting system.

We suggest, besides the compulsory financial report – as per IFRS – to implement a three-tier controlling system concentrating on cost centre accounting and project costing including allocation of overhead and other indirect costs, which would require with all three components:

- Cost Elements: (what kind of costs), which are the equivalent of the line items extracted from financial accounting;

- Cost Centres: (who is doing the spending), which are the equivalent of the hierarchical organisational units; and

- Cost Units or Cost Objects: (for what or why are we doing it), which are very peculiar controlling elements, because they are multifaceted and fulfil various functions in a controlling process.

We will define the functional requirements for the new ERP system along these lines to determine a suitable ERP System, which is able to deliver such vital information.

2.5   Procurement & Materials Management

Procurement and Materials Management is one of the three major areas or activities in an organisation. It is the procurement process which deals with getting goods and/or services for ECG's needs to fulfil its business obligations.

Materials Management is the bordering process concerned with the inflow and outflow of materials the procurement process has managed to obtain. Materials Management may include material planning and control, receiving of material in the right quantity and quality, inventory control, inter-organisational material movement and transfers.

Given the proximity of both procurement and Materials Management with ECG's environment we are dealing with the components as one integral part, which is concluded by the execution of payment in the Accounts Payable process (see point 2.3.3).

The process itself contains various subcomponents:

- Supplier/Vendor Registration (Master Data)

- Requisition and Ordering

- Procurement

- Goods Receiving

- Stock Transfer

- Material Issue

The processes are described in more detail below.

2.5.1   Supplier/Vendor Registration (Master Data)

This process has been consolidated into one subprocess combining and streamlining the registration and approval of any type of supplier of goods and services, contractors as well as pre-paid vendors who wish to do business with ECG under the same harmonised conditions. This process pertains to:

- Supplier/Vendor Registration

- Pre-paid Vendor Registration

- Registration of Contractors

For more details see point 2.1.2 Vendor Registration.

2.5.2   Material Requirements Planning (MRP)

Material requirements planning (MRP) is a system for calculating the materials and components needed for operating and maintaining of ECG services. It consists of three primary steps: taking inventory of the materials and components on hand, identifying which additional ones are needed and then scheduling their production or purchase on time

Almost all MRP systems are software-based and intended to simultaneously meet three objectives:

- Ensure materials are available for production and products are available for delivery to customers.

- Maintain the lowest possible material and product levels in stores

- Plan operating activities like "New Connections", maintenance schedules and related purchasing activities.

Table 21: Material Requirements Planning

Descriptor	Details
Process Name	Material Requirements Planning
Description	The process is set to ensure that required material are available on time and all times.
Goal	The objective to maintain appropriate stock levels without overstocking and binding capital;
Assumptions	A fully integrated supply chain management is required for the process to function.
Interfaces	MRP needs data from: • Stock Transfer process • Material Issue process • Procurement process • Inventory Process
Components	Process is a component of the: Materials Management Process.
Data Sources	Requesting departments as well as AMC
Start Event (triggered by)	It is a continuous process triggered by the material issue process

Inputs	Name	Source	Frequency	Volume	Media
	Material Issue	Inventory	Daily to weekly	Varying	ERP System

Outputs	Name	Destination	Frequency	Volume	Media
	Purchase	Procurement Department	Daily to weekly	Varying	ERP System Orders

Reporting	Stock level and Purchasing reports.
Complexity	The complexity of the business process is medium to high.
Organisational or Process Alignment	Needs to be integrated into the procurement department
Roles Involved	• GM Procurement • Procurement Manager • Procurement officer • Managers of initiating department • Requesting party

2.5.2.1 Flow Diagram Process – Material Requirements Planning

Figure 19: Flow Diagram: Material Requirements Planning
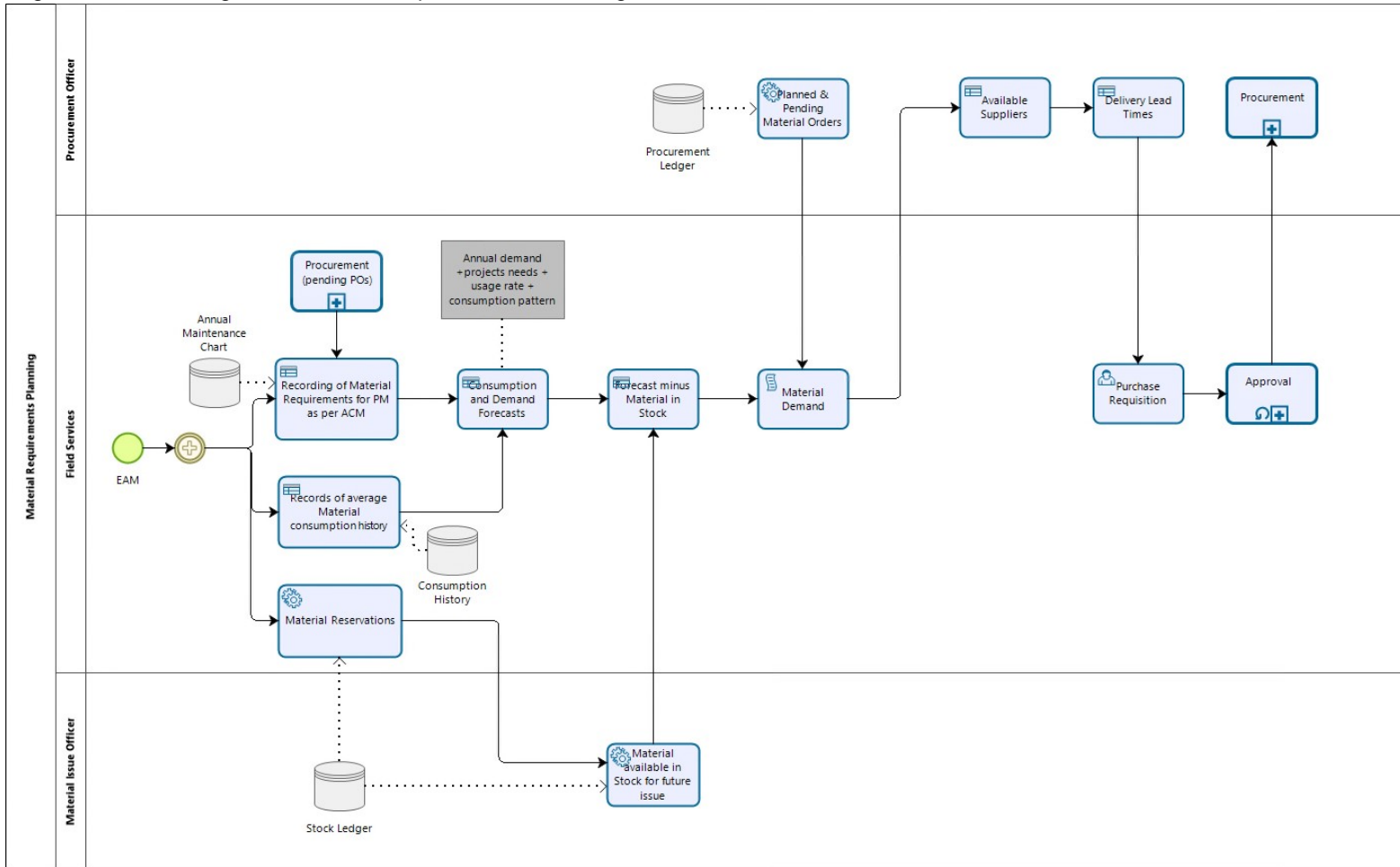
2.5.3   Requisition and Ordering

The Requisition and Ordering process initiates the procurement of any type goods and/or services by receiving the requisition, obtain approvals before issuing the actual order. From an ERP point of view, there is a clear distinction between the requisition and the ordering components of the process, in that the requisition has no formal accounting consequences – in plain words you can require / wish anything you like - only if the actual order is submitted, it becomes accounting relevant and an obligation needs to be raised, because the vendor needs to be paid and funds need to be reserved.

Table 22: Requisition and Ordering

Descriptor	Details				
Process Name	Requisition and Ordering				
Description	Requesting department prepares a Purchase Request (PR) which either gets verified in the stores or is returned back with objections. Verified PRs are forwarded to procurement department which are reviewed and if found acceptable are checked for budget availability. The un-verified ones are returned for corrections. Emergency procurement requests are routed to accounts and a formal approval obtained after recording it as emergency action while normal procurement requests after passing the budget check are sent to store officer for checking availability of stock. If the requested items are available in other stores, then Stock Transfer (ST) process is invoked. In the case where requested goods are available ex-stock within the local store then material issue process is invoked. In the eventuality where the requested goods are not available in any ECG store then it enters procurement process after passing through the approval process.				
Goal	To efficiently process all procurement requisitions and provide ex-stock goods rather than procuring the same material and increasing ECG's inventory.				
Assumptions	A fully integrated supply chain management is required for the process to function				
Interfaces	Process interfaces with: ▪ Stock Transfer process ▪ Material Issue process ▪ Procurement process ▪ Approvals				
Components	Process is a component of the: Materials Management Process.				
Data Sources	Requesting departments				
Start Event (triggered by)	Purchase requisition raised by the user.				
Inputs		Name	Source	Frequency	Volume	Media
		BOQs	User departments and projects	10 per week	700 per week	Paper and/or web based
Outputs		Name	Destination	Frequency	Volume	Media
		Material is delivered	End user department	300 per day	2100 per week	Paper and/or email
		Material is sourced	Procurement Department	3 per week	66 per month	Paper and/or email
Reporting	Stock transfer and issuance report				
Complexity	The complexity of the business process is medium.				

Organisational or Process Alignment	▪ Some organisational adjustments should be expected when consolidating the ordering functions into a more centralised function within the procurement department. While requisitions are obviously decentralised, from an ordering point of view districts and regions will need to be looked at, because the ERP system eliminates any border or obstacles to communication. ▪ Approval will be done electronically and does not need any human intervening support. ▪ There is certainly a necessity to reorganise the requisition and ordering process to reduce the involvement of the number of As-Is process participants.
Roles Involved	▪ GM Procurement

	▪ Procurement Manager ▪ Procurement officer ▪ Managers of initiating department ▪ Requesting party

2.5.3.1 Flow Diagram Process – Requisition and Ordering

Figure 20: Flow Diagram: Requisition and Ordering
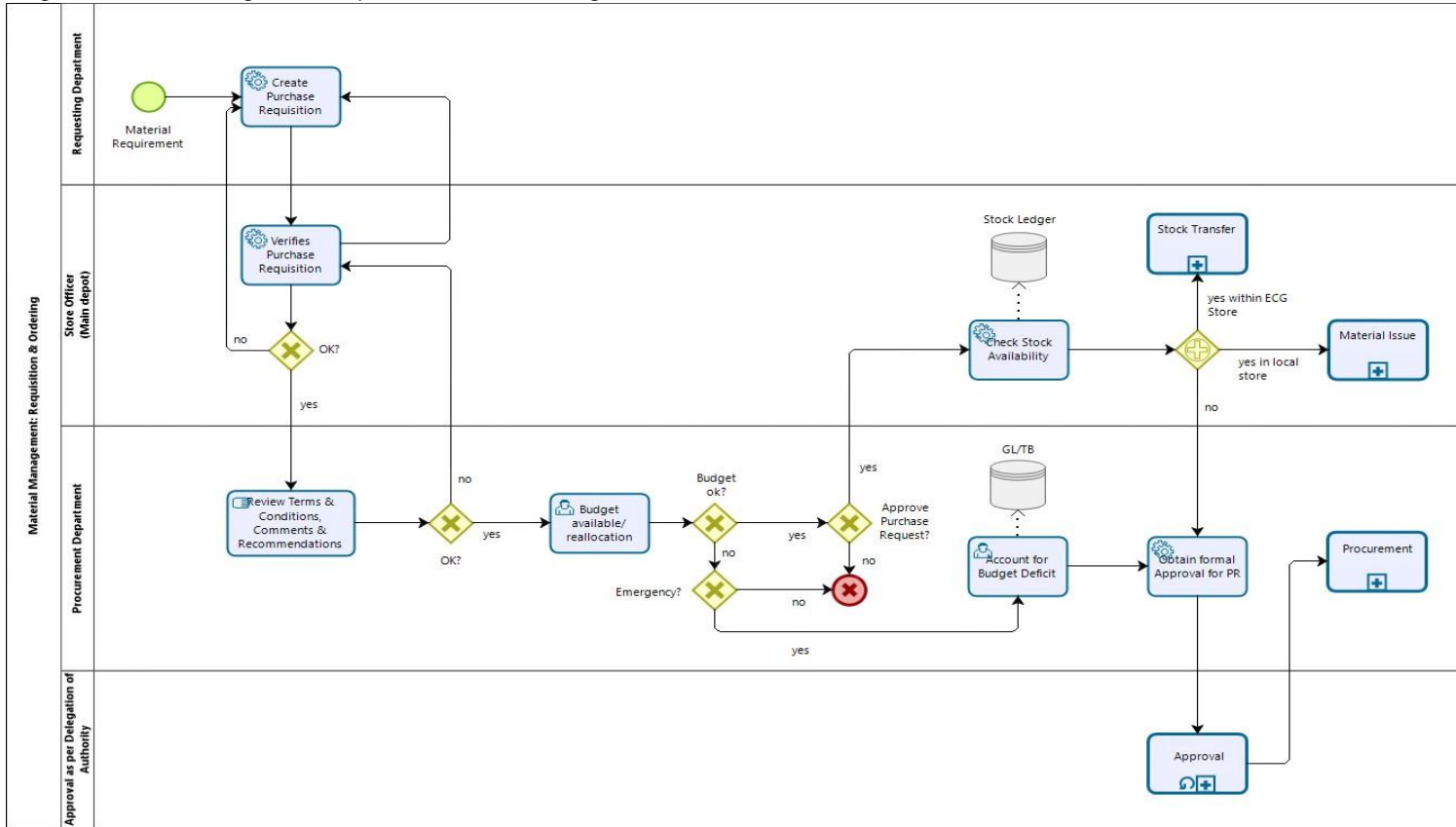
2.5.4   Procurement

The procurement process in an organisation of a certain size - like ECG – is strongly formalised and consists of either a

1)   Free hand ordering

2)   Quotation Mechanism, or a

Descriptor	Details
Process Name	Quotation
Description	For procuring goods procurement calls for quotations from the registered vendors. Interested suppliers/vendors submit quotations within the deadline. When suppliers submit quotations, they are checked for validity and relevance. If found deficient clarifications is sought from the relevant supplier. If quotations are found valid and usable then their contents are entered into the system and the responding suppliers are checked for any red flags. If vendor is not approved, then the vendor is told to get prequalified.
	Contractors' submittals are reviewed by the requestor and procurement team is provided with its expert advice on the submittals. This also forms the basis of revised bidding and contract negotiations with the selected contractor.
	When all vendors are on the approved list then the most responsive vendor is selected and a draft Purchase Order (PO) is created. The PO then enters the approval process.
	After receiving approval the Good Received process gets invoked.
Goal	The most suitable supplier is selected for meeting the requirement of ECG within the constraints specified in tender document to achieve optimal performance. It is important to follow a set process to maintain transparency in all procurements and provide a level playing field to all suppliers. Further, ECG needs to be compliant to public procurement rules and regulations of Ghana. This will also assure compliance to them.
Assumptions	None
Interfaces	This process is required to interface with the following other processes:
	▪ Process interfaces with: Vendor Requisition
	▪ Process interfaces with: Approval
	▪ Process interfaces with: Goods Received
Components	Process is a component of the: Procurement Process
Data Sources	None other than the module itself

Start Event (triggered by)	▪ Stock replenishment requests ▪ Annual Procurement Plan ▪ Procurement of goods requests from ECG offices

3) Formal Tender or Framework agreement process aiming at finding, agreeing terms and acquiring goods, services or works from an external vendor or service provider. The process is used to ensure the buyer receives goods, services or works at best possible prices, with the right quality, quantity and on time. Clearly defined processes are intended to encourage fair and open competition, while minimizing the risks, such as exposure to fraud and collusion.

2.5.4.1   Quotation

A quotation usually deals with smaller requirements under a certain threshold level but formalises the procurement process and reduces the possibility of underhand dealings.

Table 23: Quotation

Inputs	Name	Source	Frequency	Volume	Media
	BOQ	ECG departments	Weekly	10 per week	Paper and web
	ToR	ECG departments	Weekly	1 per week	Paper and web
Outputs	**Name**	**Destination**	**Frequency**	**Volume**	**Media**
	Purchase Orders	Suppliers Accounts Materials Management Requesting Department	10 per week	520 per annum	Paper and/or email
Reporting	Weekly POs outstanding report				
Complexity	The complexity of the business process is medium.				
Organisational or Process Alignment	Organisational adjustments needed regarding a stronger centralisation of procurement in general. However, it needs to be considered at which point a centralisation as compared to a decentralised function is beneficial, e.g. not every simple purchase need to follow the whole process. Within limits direct awards should be in place.				
Roles Involved	The composition of the procurement approvals is dependent on thresholds levels and determines the engaged parties, which will vary but can included the following roles and need to be established in the ERP System with the corresponding user rights: ▪ Procurement Manager ▪ General Manager Procurement ▪ Director Procurement ▪ Managing Director ▪ Financial Accountants ▪ Managers of requesting department ▪ Requesting party				

2.5.4.2 Tender

The tender process usually deals with larger projects or consignments over certain threshold levels and is usually a highly formalised endeavour to ensure an open and transparent competition receiving optimal quality at best prices to the benefit of ECG.

Table 24: Tender

Descriptor	Details				
Process Name	Tender				
Description	For procuring goods procurement calls for tenders from registered vendors and circulates in the press. The requesting department develops the Terms of Reference (ToR) document and procurement processes the ToRs for approval. Upon receipt of approval a Tender is published for invitation of proposals. Tenders/Proposals are received at the ECG headquarters and the Tender Committee opens the tenders on the appointed date. Tender committee begins evaluation of all submitted proposals. Tender committee recommends the most responsive supplier's proposal for award and creates a draft PO/agreement for approval. The PO/Proposal & Agreement enter the approval process and after receiving approval the Good Received process gets invoked.				
Goal	The most suitable supplier is selected for meeting the requirements of ECG within the constraints specified in tender document to achieve optimal performance. It is important to follow a set process to maintain transparency in all procurements and provide a level playing field to all suppliers. Further, ECG needs to be compliant to public procurement rules and regulations of Ghana. This will also assure compliance to them.				
Assumptions	None				
Interfaces	This process is required to interface with the following other processes: ▪ Vendor Requisition for registration with the tender documents ▪ Approval ▪ Goods Received				
Components	Process is a component of the: Procurement Process				
Data Sources	None other than the module itself				
Start Event (triggered by)	▪ Stock replenishment requests ▪ Annual Procurement Plan ▪ Procurement of goods requests from ECG offices				
Inputs	**Name**	**Source**	**Frequency**	**Volume**	**Media**
	Identify inputs into the process	Identify where data comes from	Identify data frequency, e.g. daily, weekly, monthly etc.	Identify volumes, e.g. # of records produced	Identify media for collecting inputs, e.g. paper, web, verbal
	BOQ	ECG departments	Weekly	10 per week	Paper and web
	ToR	ECG departments	Weekly	1 per week	Paper and web
Outputs	**Name**	**Source**	**Frequency**	**Volume**	**Media**
	Contracts/ Agreements	Suppliers Accounts Materials Management Requesting Department	1 per week	52 per annum	Paper and/or email
Reporting	Monthly progress report				
Complexity	The complexity of the business process is medium.				

Organisational or Process Alignment	Even more than in the quotation process, the tender process requires organisational adjustments needed with regard to a stronger centralisation of procurement in general.
Roles Involved	The composition of roles for a tender process is dependent on thresholds levels and determines the engaged parties, which will vary but can included the following roles and need to be established in the ERP System with the corresponding user rights:

	- Managers of initiating department - Procurement Manager - General Manager Procurement - Director Procurement - Managing Director - Financial Accounts

2.5.4.3   Flow Diagram Process – Procurement

Figure 21: Flow Diagram: Procurement
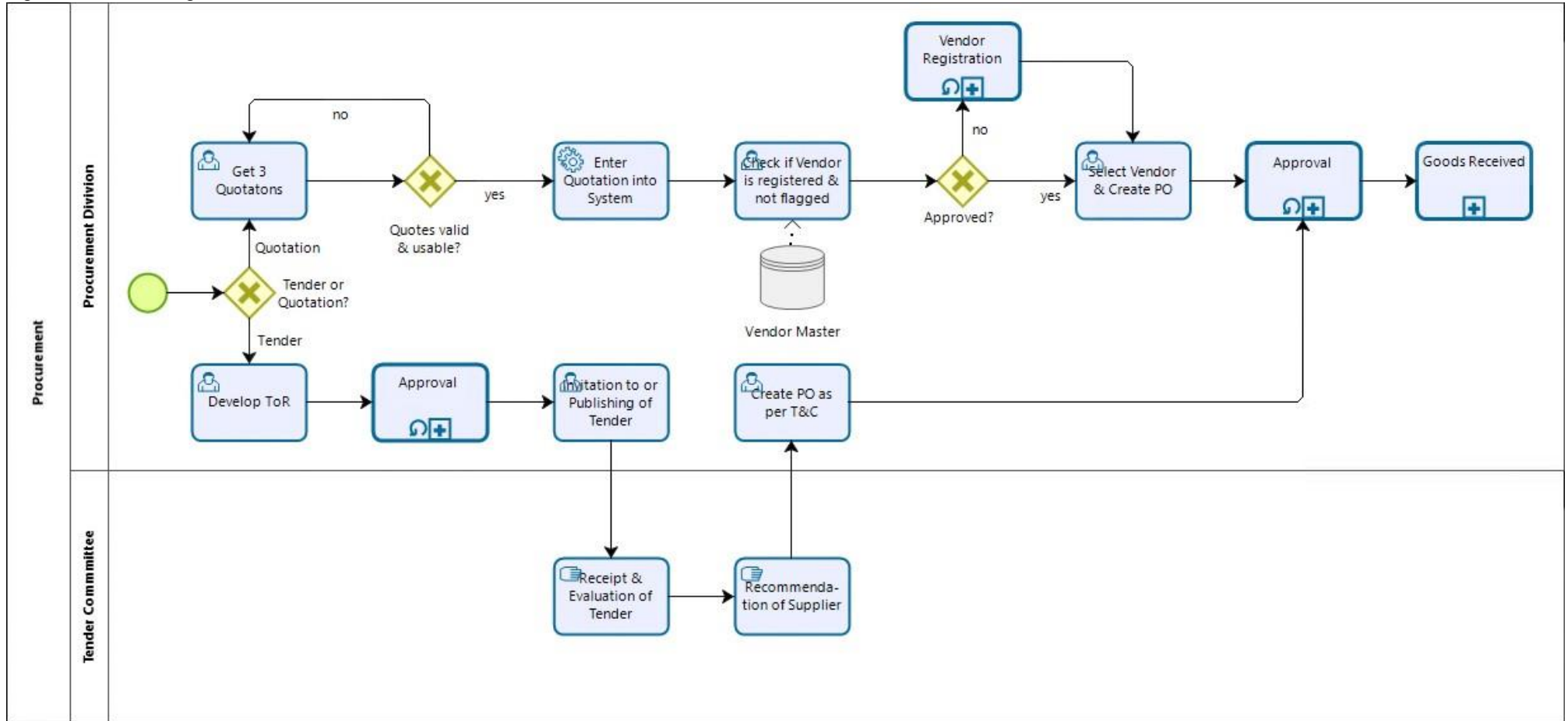
2.5.5   Goods Receiving

Once a quotation or tender is awarded and the ordered supplies are delivered this initiates the Goods Receiving process.

Goods are received and checked for quality and quantity compared to the actual order before it is received or respectively transferred into the warehouse, from which the material is available for further disposal.

A service received process is the minimal version of the goods received process and happens on a more decentralised basis, i.e. an onsite check – like as-build – verifies and approves service delivery. There it is not a classical service received process but integrated into another process as individual tasks like for example as-built compliance.

Table 25: Goods Receiving

Descriptor	Details				
Process Name	Goods Receiving				
Description	Goods/Materials are received in the receiving bay of the respective store/depot after security clearance at the gate of the establishment after completion of procurement process and per the agreed delivery schedule.				
	The receiving bay officer at the receiving bay receives all material that is to be delivered by vendor(s) after security checking of the goods at the gate of the Depot/Store. At the bay quality and quantity of the goods is checked by receiving bay officer and the store keeper.				
	In the case where goods are not according to the agreed quality they are not accepted and returned to the supplier. In the case where goods are of the required quality they are taken on the Depot/Store charge by raising a Goods Received Note (GRN). Any short deliveries are flagged as such in the vendor master data. GRN gets approved and the material is checked in to the respective storage location.				
	The requesting ECG entity is issued the material while finance processes supplier(s) invoice(s) for payment.				
Goal	To receive materials in the responsible Depot or Stores at the required quality and quantity.				
Assumptions	There no assumptions in this process				
Interfaces	▪ Process interfaces with: Material Issue process ▪ Process interfaces with: Payment process (AP)				
Components	Process is a component of the: Materials Management Process.				
Data Sources	Purchase Orders Contracts/Agreements				
Start Event (triggered by)	Delivery notification from supplier/vendor				
Inputs	**Name**	**Source**	**Frequency**	**Volume**	**Media**
	Suppliers Delivery notice	Purchase orders/ contracts/ agreements	500 per month	6000 per annum	Paper and/or email in future ERP supported invoice submittal can be installed
Outputs	**Name**	**Destination**	**Frequency**	**Volume**	**Media**
	GRNs are raised	Receiving Bay	500 per month	6000 per annum	Purchase order to be turned into GRN on ERP system
	Suppliers Invoices are received	Finance Department	500 per month	6000 per annum	Paper and/or email in future ERP supported invoice submittal can be installed

Reporting	Deliveries Reporting done with every discrete material receiving event in the Depot/Store

Complexity	Medium
Organisational or Process Alignment	▪ At first glance adjustments required, only the roles in the process are reduced. ▪ However, this process and its organisational background is rather dependent on investigating the organisational structure of the warehouses and needs to be adjusted accordingly.
Roles Involved	▪ Suppliers/Vendors ▪ Receiving Bay officer ▪ Stores officer ▪ Manager Supplies

2.5.5.1   Flow Diagram Process – Goods Receiving

Figure 22: Flow Diagram: Goods Receiving
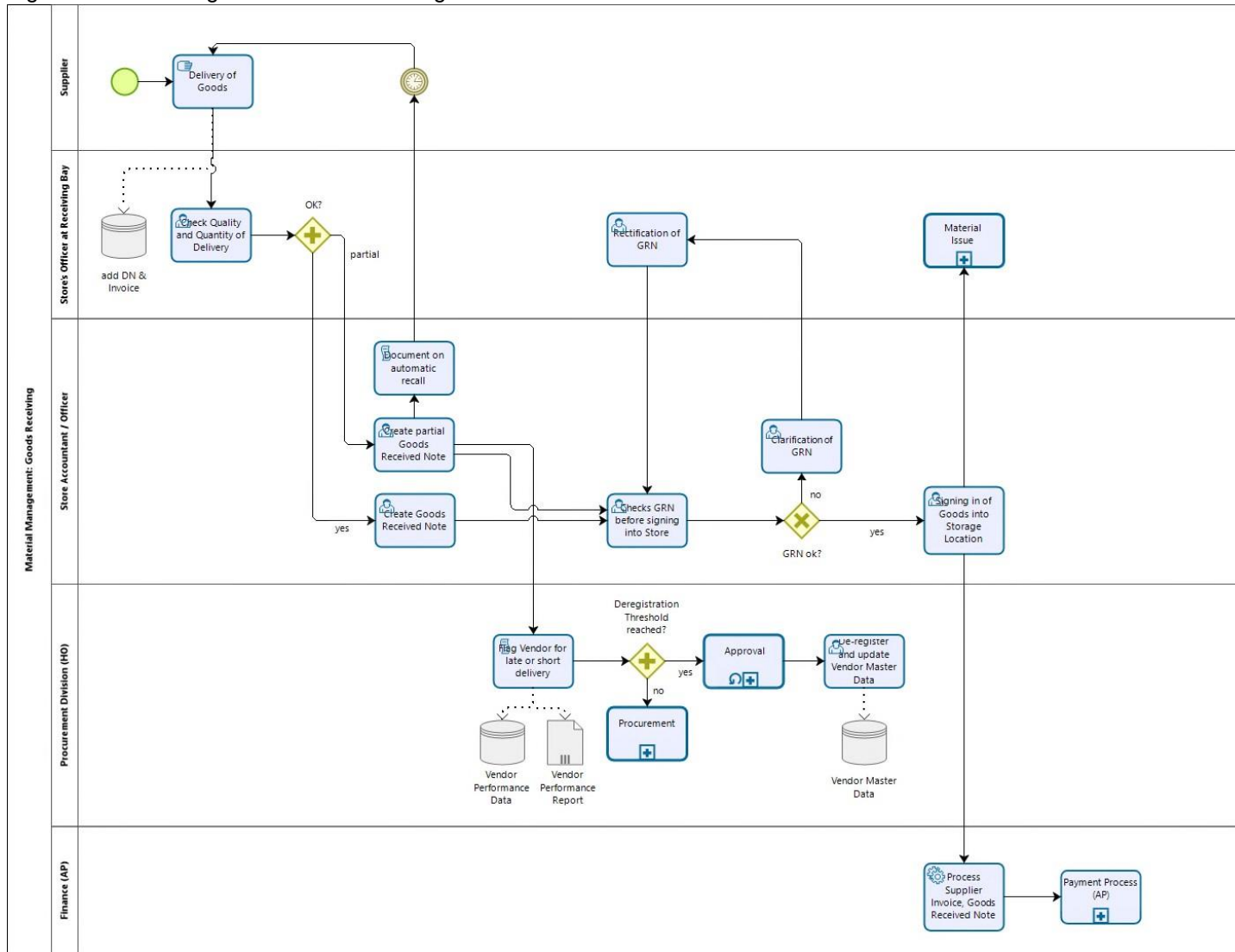
2.5.6   Stock Transfer

For a stock transfer to take place, materials need to be already available in the central warehouse or in decentralised stores. Prerequisite for a stock transfer is that material is not reserved for any other proposes and is moveable without time and effort and without incurring more cost than the material is worth. The process has two elements: a requesting / receiving side and a releasing side. Therefore, the process - even though being strictly formalised - requires individual decisions to take place. The decision can be delegated to an appropriate level without triggering an elaborate approval procedure.

Table 26: Stock Transfer

Descriptor	Details				
Process Name	Stock Transfer				
Description	When material requisitions (MRs) are received in the depot/stores Stock Transfer (ST) activity starts. ST happen from Main Depot to all Regional Stores (RS), and all ECG directorates and divisions except the district offices. In the same vein, MRs from Regional Offices and District Stores (DSs) get processed in RSs while MRs generated in the District Offices are processed in the DS. The ST process commences upon receipt of MR by the store clerk who checks the availability of the requested material. If the material is available in the required quantities, then it is issued to the requestor. In the case when material is not present in the store availability is checked in other stores. If the material is available in the requested numbers, then it is issued to the requestor otherwise Requisition & Ordering process is initiated. Goods are finally received by the requestor and the stock transfer process is completed.				
Goal	To ensure smooth transfer of material from a store to another or to an end user department for deployment in the field.				
Assumptions	There no assumptions in this process				
Interfaces	Process interfaces with: ▪ Material Issue Process ▪ Requisition & Ordering Process ▪ Goods Received				
Components	Process is a component of the: Materials Management Process.				
Data Sources	▪ All ECG Offices ▪ Material Requisitions (MR)				
Start Event (triggered by)	Approved MR received in a store				
Inputs	Name	Source	Frequency	Volume	Media
	Material requirement	All ECG offices	7000 per month	84000 per annum	Paper and web
Outputs	Name	Destination	Frequency	Volume	Media
	Material is issued	Requestor of material	300 per day	90 per month	Paper and email
	Requisition and Ordering is done	Procurement	10 per week	2100 per week	Paper and email
	Goods are received	Store Management	500 per month	6000 per annum	Paper and email
Reporting	Deliveries Reporting done with every discrete material receiving event in the Depot/Store				
Complexity	The complexity of the business process is medium.				
Organisational or Process Alignment	This process and its organisational background is rather dependent on investigating the organisational structure of the warehouses and needs to be adjusted accordingly.				
Roles Involved	▪ Requester of material ▪ Stores Officer / Manager issuing store or warehouse ▪ Stores officer / Manager receiving store or warehouse				

2.5.6.1   Flow Diagram Process – Stock Transfer

Figure 23: Flow Diagram: Stock Transfer
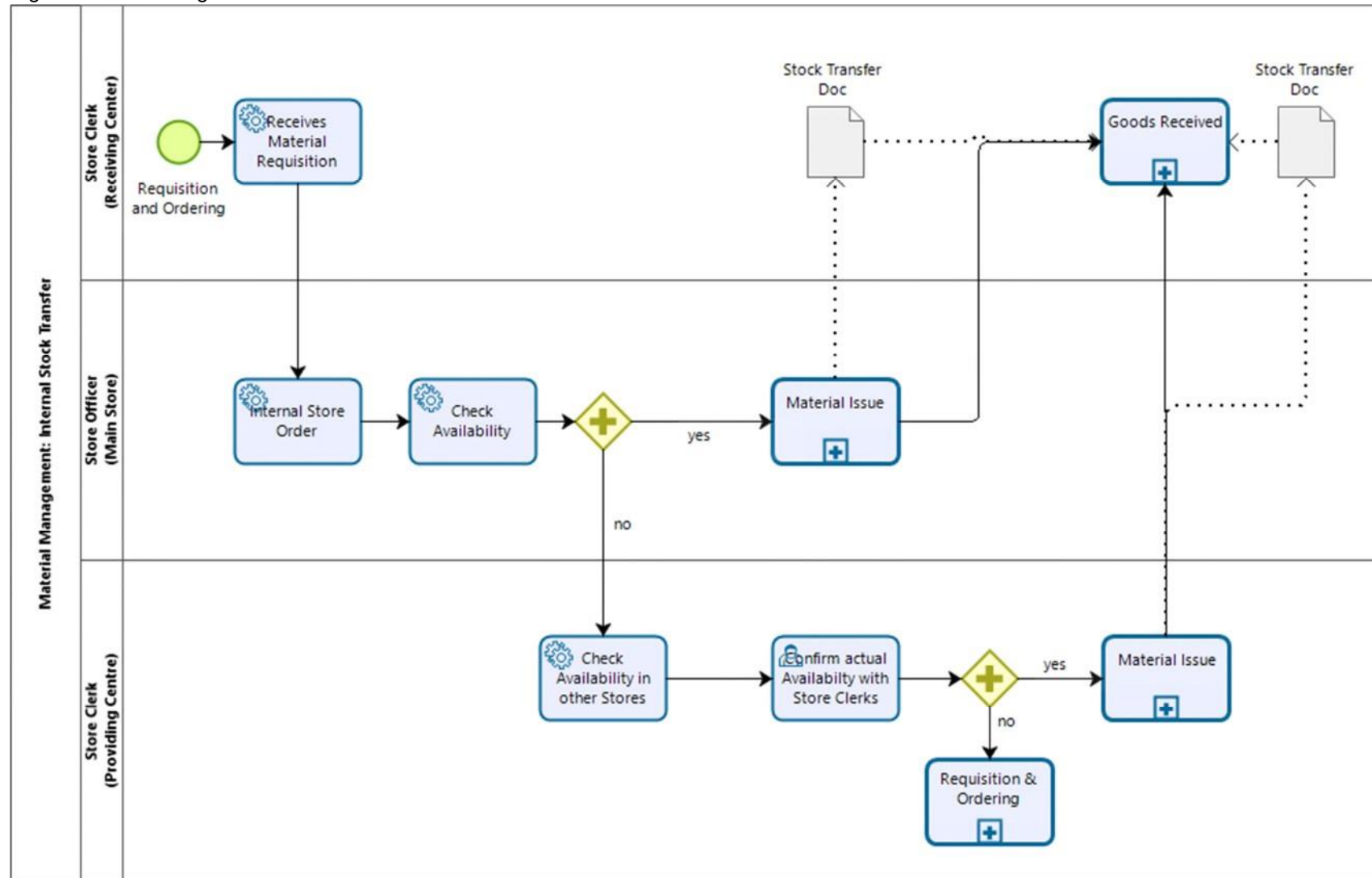
2.5.7 Material Issue

The start of the Material Issue process is also a request for material, but this material has already been purchased and is available to be issued from a warehouse or a store. This is done via a material (issue) requisition upon which material is reserved for a particular purpose/project or the requesting person. Any additional request for the same material – if not in any other store – will be regarded as a purchase requisition and will trigger another purchase order in the ordering process.

Table 27: Material Issue

Descriptor	Details				
Process Name	Material Issue				
Description	Material Requisitions are raised by employees/departments mainly for four activities: ▪ Material needed for offices ▪ Meters and installation material need for service connections ▪ Material needed for maintenance jobs ▪ Material needed for developmental projects The store keeper checks on the ERP system the availability of material in the required quantity in the depot/stores before the material can be issued to the requestor. If the material is available as demanded, then the material is reserved for the requestor even before to is issued and acknowledgement obtained on the material issue document. Any material which is reserved is regarded as not available and a further subsequent request will trigger automatically trigger a purchase order for approval. In the eventuality when material is not available in the store then other stores are checked via the ERP system about the availability of material with them. If a store responds in affirmative, then Stock Transfer process is initiated otherwise Procurement process is kicked off.				
Goal	To ensure smooth transfer of material from a store to another or to an end user department for deployment in the field.				
Assumptions	There no assumptions in this process				
Interfaces	Process interfaces with: ▪ Material Issue Process ▪ Requisition & Ordering Process ▪ Goods Received ▪ Stock Transfer				
Components	Process is a component of the: Materials Management Process.				
Data Sources	▪ All ECG Offices ▪ Material Requisitions				
Start Event (triggered by)	Approved MR received in a store				
Inputs	**Name**	**Source**	**Frequency**	**Volume**	**Media**
	Material requirement	All ECG offices	7000 per month	84000 per annum	Paper and web
Outputs	**Name**	**Destination**	**Frequency**	**Volume**	**Media**
	Material issued	Requestor of material	300 per day	90 per month	Way bill issued via ERP system
Reporting	Deliveries Reporting done with every discrete material receiving event in the Depot/Store				
Complexity	Medium				
Organisational or Process Alignment	Some adjustments are required regarding the store and/or warehouse locations which would then also affect the organisational structure. In addition, the introduction of a Field Service module will to an extend also affect the material issue procedure.				
Roles Involved	▪ Manager Supplies ▪ Procurement Manager ▪ Manager Stock Planning & Control ▪ Stores Officer ▪ Requester / Recipient				

2.5.7.1 Flow Diagram Process – Material Issue

Figure 24: Flow Diagram: Material Issue
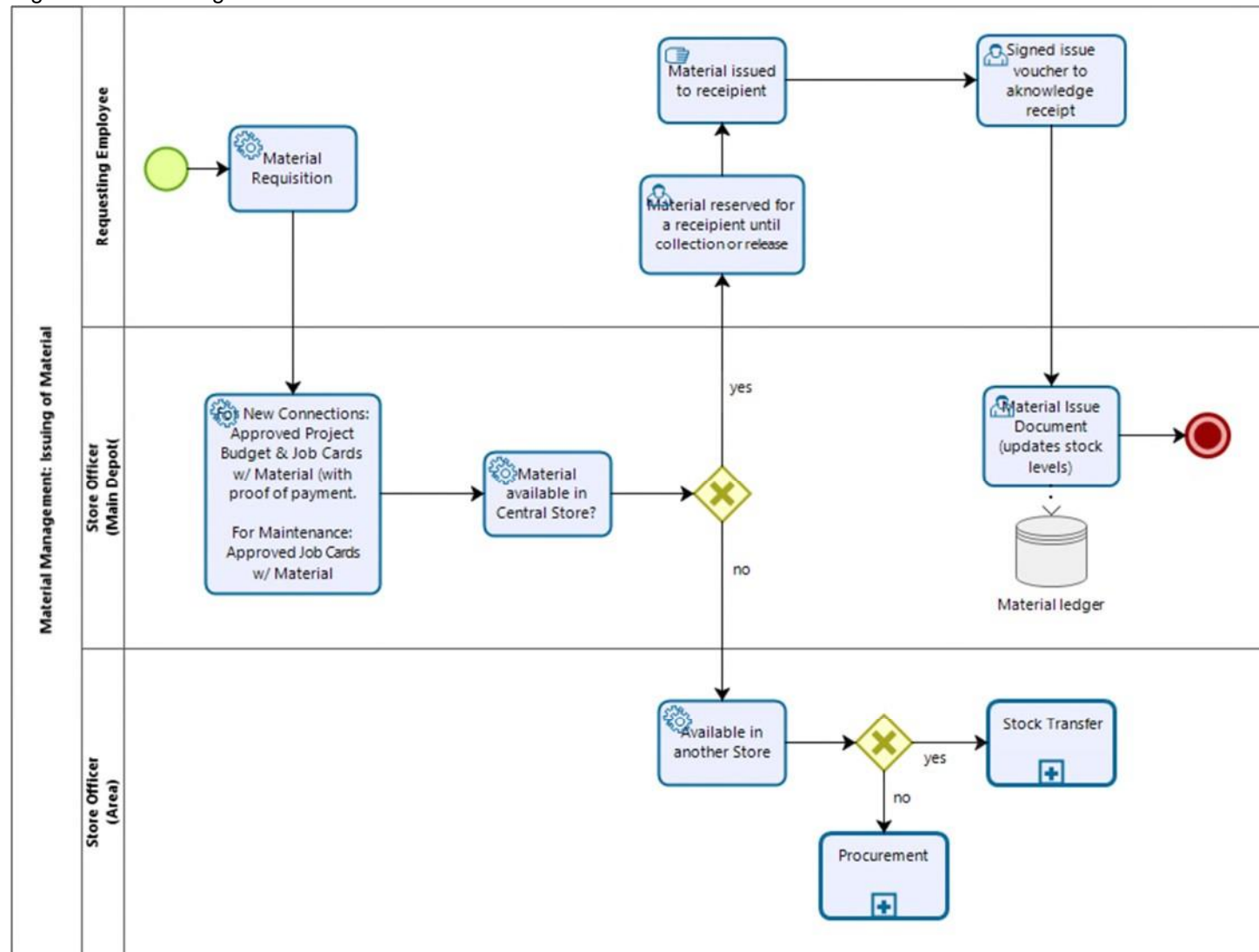
2.5.8 Estate Management

Office management and services revolving around their maintenance and upkeep are a function of Estate Management (EM). Additionally, purchase of properties is also in the domain of EM.

Table 28: Estate Management

Descriptor	Details
Process Name	Estate Management
Description	Estate Management within ECG plays the following two roles: ▪ Acquisition of Property ▪ Facility- and Service Management ECG's expanding network requires more office space and more substations and tower lines to be built and deployed. This requires acquisition of property and securing right of way so that business does not suffer. The acquisition could be an outright purchase of property with transfer of title in the name of ECG or a lease agreement or a rental agreement. When purchase of property is negotiated then a sales deed (contract) is drafted and sent to the legal team for review. After favourable review the draft sale deed is sent to the higher management for approval by invoking the approval process. Upon receipt of approval Estates gets the sales deed operational and initiates the payment process after which the demised property is taken over. When properties are rented or taken on lease then contract management process is initiated. Financial process to make rental and/or lease payments is initiated at regular intervals per the agreements/contracts. Facilities Management activities can be managed in house or outsourced to third party contractors. The outsourced services are obtained by developing draft ToRs and Service Contract which is submitted for legal review. Upon passing legal review the ToRs and Service Contract enter the Approval Process. Afterwards procurement process is initiated to obtain the envisioned services and Contract Management process is invoked for that contract. Financial process to make payments is initiated at regular intervals per the terms of the agreements/contracts. All service requests are followed by work scheduling of all assignments so that prompt response can be provided. In the case where equipment is needed then procurement process is initiated to meet the service needs. Finally, job completion endorsement is obtained from the service requestor.
Goal	To purchase properties for ECG to facilitate growth and manage and maintain all facilities to a high standard.
Assumptions	There no assumptions in this process
Interfaces	Process interfaces with: ▪ Legal Review ▪ Approval process ▪ Financial (AP) process ▪ Procurement process
Components	Process is a component of the: ▪ Estates process
Data Sources	▪ HQ directions ▪ Contracts ▪ Contractor submittals
Start Event (triggered by)	▪ Head Quarters expansion plans ▪ Service requests received from end users

Inputs	Name	Source	Frequency	Volume	Media
	Contractual Services	All directorates	Daily	50	Paper, Verbal Phone
	Supply of Equipment	All directorates	Daily	10	Paper, Verbal Phone
	Repairs & Maintenance services	All directorates	Daily	5	Paper, Verbal Phone
Outputs					

	Name	Destination	Frequency	Volume	Media
	Contractual Services	Legal	Daily	50	Paper, Verbal Phone
	Supply of Equipment	Procurement	Daily	10	ERP System - Procurement
	Repairs & Maintenance services	Procurement	Daily	5	ERP System - Procurement
Reporting	▪ Monthly project status reports ▪ Project Success rate ▪ Time and Cost Analysis ▪ Efficiency ratings & exception reporting				
Complexity	High				
Organisational or Process Alignment	Taking note of the fact the state department arranges building to be purchased or rented. and then organises facility management, i.e. cleaning and repairs, it remains the question whether their participation in the design of projects necessarily requires a separate organisational unit. Furthermore, it can be considered that the acquisition sequence is not a procurement function. The same question arises for the facilities management task, where it is not clear how much work is outsourced or handled with ECG personnel.				
Roles Involved	Teams involved in the tasks ▪ Acquisition / Renting of Property / Procurement ▪ Procurement of Facility Management Services ▪ Workforce management, for ECG internal facility management staff				

2.5.8.1 Flow Diagram Process – Estate Management

Figure 25: Flow Diagram: Estate Management
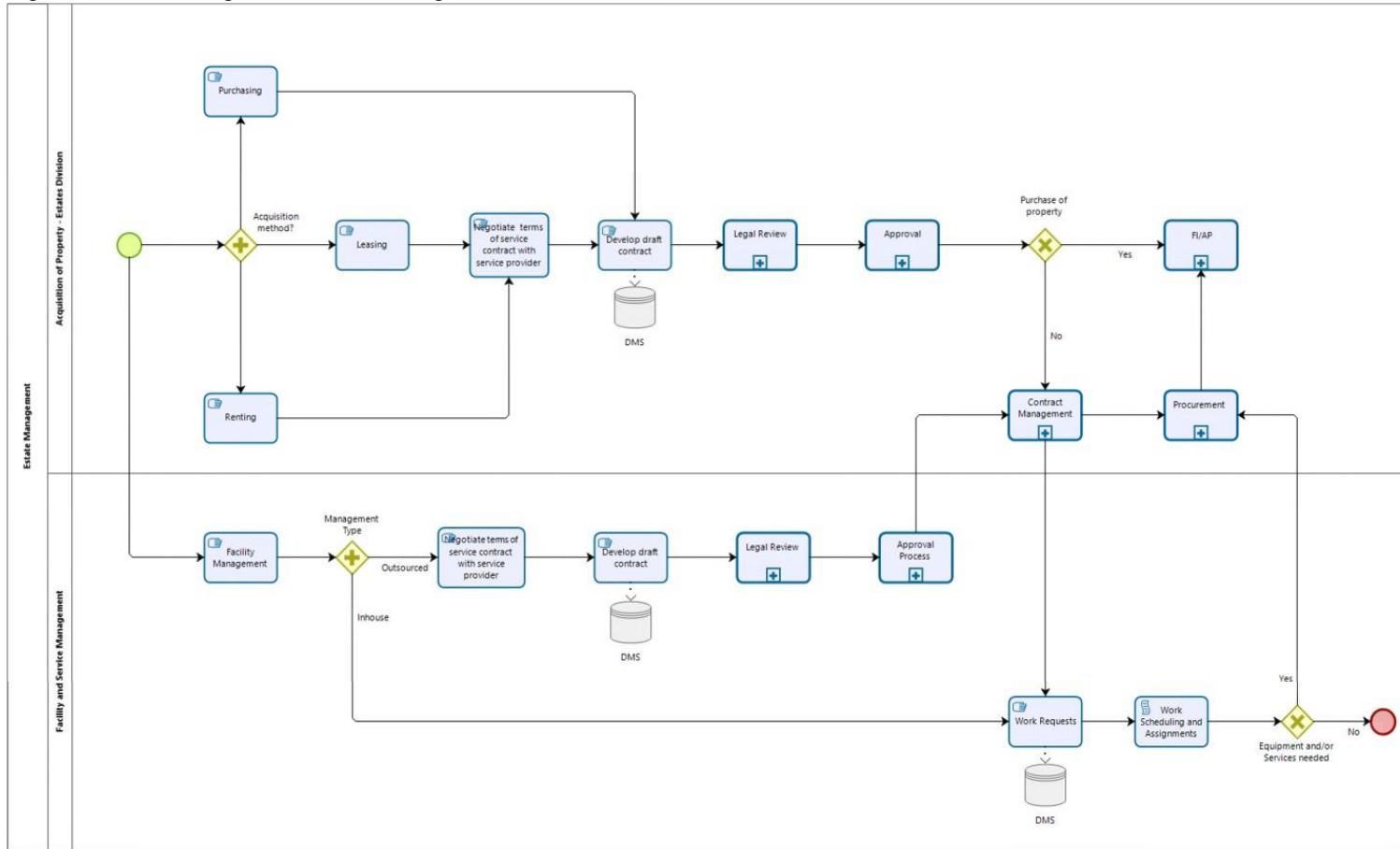
2.6 Enterprise Asset Management

Enterprise Asset Management (EAM) components – which are not to be mistaken with a Fixed Assets Systems - aim at managing all of ECG's assets across departments, facilities, business units and geographical locations. EAM integrates techniques for all-inclusive control and optimization throughout asset life cycles, including design, commissioning, operations and replacement. ECG asset management deals with keeping all its operational assets such as transformers, substations, transmission lines and ancillary equipment in good operational condition. All infrastructure assets are tracked, and their maintenance history maintained to drive analytics. Another mandatory practice is to track all support / maintenance / fault calls which are allocated to the respective units via a Call Centre and Field Service / Workforce Management application (see 2.1.3).

Besides the mentioned Field Service application, it requires an interface with Fixed Assets Systems and GIS to keep the equipment data tied to location data i.e. functional location for effective response and tracking. This also allows optimising workforce deployment since failures become quite predictable over time.

2.6.1 Annual Maintenance Chart (AMC)

The AMC sets up maintenance priorities and assists field functions to scheduled downtimes for maintenance to make it more predictable for themselves and customers. It helps improve productivity of the maintenance groups and team members who handle daily operational work.

It is clearly to be differentiated from breakdown maintenance, which is differently organised than any type of scheduled maintenance.

Table 29: Annual Maintenance Chart

Descriptor	Details
Process Name	Annual Maintenance Chart

Description	ECG does Planned Maintenance and Breakdown / Emergency Maintenance to keep its assets in operational condition. Planned Maintenance activities follow an approved Annual Maintenance Chart (AMC) that the HO shares with all Regional Offices and Sub-T Division. The AMC is broken down into months and weeks. The following are part of the AMC:

Item No.	Activity
1	Routine Inspection / Preventive Maintenance / Load Monitoring / Housekeeping of Secondary Substations
2	Number of substations to be inspected (Target) in activity (1)
3	Shutdown / Corrective Maintenance of selected secondary substations
4	Routine inspection of switching substations
5	Shutdown Maintenance of switching stations
6	Fumigation of secondary substations
7	Routine Inspection / Shutdown Maintenance of 11kV oil-filled switchgears (RMU, EOS, EFS) and gas-insulated and vacuum switchgears
8	Routine inspection /patrol of 33kV/11kV/LV OHL
9	Circuit km (33kV/11kV OHL) to be inspected/patrolled in activity (8)
10	Circuit km (LV) to be inspected / patrolled in activity (8)
11	Shutdown Maintenance of 33kV/11kV OHL for identified problems in activity (8)
12	33kV/11kV/LV OHL bush clearing and tree felling
13	Inspection and servicing of 33/11kV load isolators and auto reclosers
14	Routine inspection / preventive maintenance of low voltage, medium voltage and high voltage underground cables end termination
15	Re-Activation of fault indicators
16	Inspection and servicing of secondary SCADA switches

Agreed targets are given against each item which the Regional Offices and Sub-T Division are required to meet. AMC is created for year-round planned maintenance.

The AMC development process starts with the Regional Offices and Sub-T Division giving their inputs to the Maintenance Division.

The AMC development process starts with the Regional Offices and Sub-T Division preparing Annual Maintenance Programmes to cover all equipment in their operational areas and forward the programmes to Head Office.

The Maintenance Engineers create the Annual Maintenance Programmes for their areas and submit them to the Regional Engineers in the Regional Offices and Maintenance Manager in the Sub-T Division for approval and further processing. After successful review in these offices they are sent to the GM Maintenance Division for approval and consolidation to obtain an ECG wide AMC. Once approved the ECG wide AMC is then shared with all Regional Offices and Sub-T Division for their portion of AMC accordingly.

Progress on AMC is tracked on a monthly basis by Regional Offices and Sub-T Division reporting to HO on the activities done for the month under review.

Data Analytics provide visibility into forecasts and help mitigation planning.

Goal	- To keep the ECG network in good operational condition - To establish and sustain a proactive scientific maintenance culture - Ensure Maximum Mean Time Between Failures for all equipment - Ensure Minimum Mean Time to Repair - Ensure the availability of adequate number of competent staff to respond appropriately to normal and emergency situations - Minimize third party encroachment on / damage to ECG plant and equipment
Assumptions	None

Interfaces	This process is required to interface with the following other processes:
	▪ Approval process
	▪ Scheduled Maintenance

	▪ HR Capacity Planning
	▪ Materials Requirement Planning
Components	Process is a component of the:
	▪ Operations & Maintenance Process / EAM
Data Sources	None other than the module itself.
Start Event (triggered by)	AMC initiation request for the next calendar year from HO Monthly progress reports

Inputs	Name	Source	Frequency	Volume	Media
	Draft AMC	Regional Offices and Sub-T Div.	Annual	1 per annum	Paper and web

Outputs	Name	Destination	Frequency	Volume	Media
	Approved AMC	Maintenance function	Annual	1 per annum	Paper and/or email
	Revised AMC	Maintenance function	Annual	1 per annum	Paper and/or email
	Service Costing	Time and attendance job Card	Regular	No. of maintenance per year	Posting secondary G/L for controlling purposes

Reporting	▪ Training of Staff
	▪ Technical Reviews/Presentations of New Products
	▪ Balanced Scorecard Activities
	▪ Progress Report on Bush Clearing
	▪ Overhead Line Patrol Performance based on set targets from AMCs
	▪ Cable Repair Work Analysis Summary
	▪ Live Line Work Report
	▪ Primary Substation Report
	▪ Distribution Substation Report
	▪ Transformer Damage and Cause of Failure Report
	▪ Refurbished Transformers Report
	▪ Transformer Test Laboratory Report (Distribution Transformer Testing)
	▪ Damaged Substation Equipment
	▪ Transport vehicles allocation and condition report
	▪ Status of instruments/equipment
	▪ Supervisory systems monthly report
	▪ Preventive maintenance performance table for secondary automation sites
Complexity	Medium
Organisational or Process Alignment	There is a necessity to check out the maintenance planning to verify the involvement of the number of process participants.
Roles Involved	▪ General Manager
	▪ Regional General Managers
	▪ Sub-T General Manager
	▪ Regional Managers
	▪ Maintenance Manager
	▪ Operations Managers
	▪ Maintenance Engineers
	▪ Maintenance Supervisors

2.6.1.1 Flow Diagram Process – Annual Maintenance Chart

Figure 26: Flow Diagram: Annual Maintenance Chart
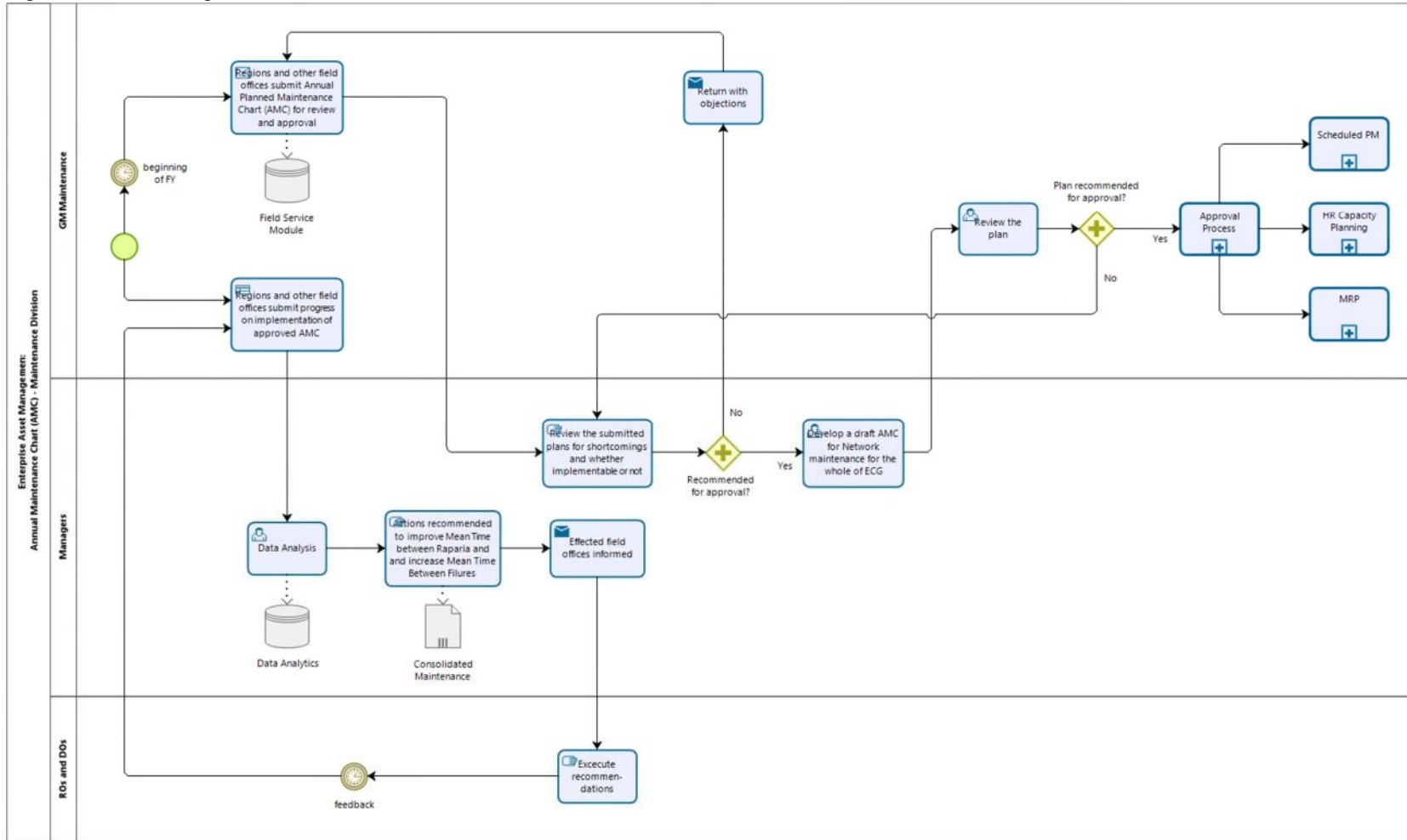
2.6.2 Operations and Maintenance (Scheduled)

ECG has effective operational controls in place whenever there is a significant deviation to a process that requires a decision or action on the technical team's part. Planners can put better controls in place since they have the necessary visibility of available versus required capacities.

Table 30: Operations and Maintenance (Scheduled)

Descriptor	Details					
Process Name	Operations and Maintenance (Scheduled)					
Description	HV/MV/LV scheduled maintenance works start once the approved Annual Maintenance Chart (AMC) is received by the Maintenance Engineer. The engineer develops a weekly plan in-line with the approved AMC. Monitoring teams get mobilised and they visit substations and patrol transmission lines to determine their condition per the weekly plan, which helps them to develop an assessment of the ECG network. If teams encounter a problem which is repairable by replacing the faulty part / component they do it straight away. If the problem cannot be rectified with replacing parts/components but require costly interventions, then they propose an appropriate solution to the manager. This may result in a full-fledged proposal to start an improvement project. The proposal gets approved following the approval process. Upon approval the proposal enters the Procurement process and results in contractor's selection and mobilisation to do the works. Materials management process is invoked, and the contractor begins building and equipment installation works. The Project Management system keeps track of the works and services progress.					
Goal	To keep the ECG network in good operational condition.					
Assumptions	None					
Interfaces	This process is required to interface with the following other processes: ▪ Field Service ▪ Procurement process ▪ Materials Management process ▪ Approval Process ▪ Processes with the Capital Projects component ▪ Project Management System ▪ Financial process					
Components	Process is a component of the: ▪ Operations & Maintenance Process / EAM					
Data Sources	None other than the module itself					
Start Event (triggered by)	▪ Approved Annual Maintenance Chart ▪ Workforce Planning on maintenance schedule					
Inputs	**Name**	**Source**	**Frequency**	**Volume**	**Media**	
	Maintenance Inspections	Internal monitors	Weekly	4-5 per month per location	ERP EAM Module	
Outputs	**Name**	**Source**	**Frequency**	**Volume**	**Media**	
	Work Orders	Fault teams	5 per day per location	1,360 per annum	ERP EAM Module & Workforce Module	
	Proposals	Fault teams	1 per month per location	260 per annum	Paper and/or email	
	Project Costing	Management Accounting	daily	Big Data	ERP Mgmt Acc via posting against the actual asset or asset category	
Reporting	▪ Weekly maintenance / repair outstanding report ▪ Plan / Actual report ▪ Time and cost report					
Complexity	Medium					

Organisational or Process Alignment	The integration with Field Service / Workforce Planning might require some reallocation of staff and organisational restructuring coming with it.
	Additionally, there is the necessity to reorganise maintenance function to reduce the involvement of the number of process participants (see below roles involved).
Roles Involved	- General Manager - Manager Operations - Maintenance Manager - District Manager - Technical Officer - Engineers - Control Supervisor - Shift heads - Mobile Teams - Maintenance Supervisors - Field Service / Workforce Planning staff

2.6.2.1   Flow Diagram Process – Operations and Maintenance (Scheduled)

Figure 27: Flow Diagram: Operations and Maintenance (Scheduled)

Enterprise Asset Management
Plant Maintenance: Scheduled Maintenance

General Manager

Monthly Maintenance Report

Consolidated Maintenance Report

Field Services

Org Unit Responsible for Asset

Obtain Approval for PM Schedule weekly plan

Approval

Maintenance Manager

Approved AMC / Workforce Planning on maintenance schedule

Consolidate & suggest annual PM schedule

Submit workforce planning to plan/ schedule inspections

Field Services

Inform Field Services

Field Services

Report on completed / pending maintenance

Job Completion Report

Maintenance Team

Inspection Job Cards

Execute Inspection

Job required?

no

yes

Request for Isolation & Work Permit

Isolation Request   Work Permit

Material required?

no

yes

Execute assigned maintenance job

Maintenance Job Card

Inform Field Services

Field Services

Stores

Material Ledger

Material Issue of reserved material

ERP To-Be Business Processes
Development of ERP System for ECG – a MiDA Ghana Project Section:
Main
ERP To-Be Business Processes
Development of ERP System for ECG – a MiDA Ghana Project Section: Main

2.6.3 Operations and Maintenance (Break-down)

Break-down in the ECG network causes power outages that require immediate response from ECG field teams to limit its impact and restore power within the shortest possible time. Breakdown can occur due to many reasons such as over load conditions, inclement weather etc.

Table 31: Operations and Maintenance (Break-down)

Descriptor	Details
Process Name	Operations and Maintenance (Break-down)
Description	**Operations:** SCADA control room shift head receives HV complaints and gives Permission to Work (PTW) to the on duty mobile operation team. The teams seeks Limitation of Access (LOA) which is approved by the Operations Manager. If the fault is with the transmission line then Trial Switching is initiated which if successful restores normal operations and the PTW and LOA are returned to the shift head. In the case of the Trial Switching is not successful in restoring normal operations then the team patrols the transmission line to find out the fault. Sectioning points is initiated which helps determine the cable fault location. Cable fault location form is filled by the team and put in the SubT Maintenance Process. If the fault is in a substation then Request for Isolation (RFI) is raised and sent to the Operations Manager for approval. He can receive this request from MV, Capital Projects and Sub-T Maintenance other than the SCADA control operations. The shift head then prepares the switching sequence to enable operator(s) to carry through the requested isolation. After which fault removals get underway. After works are done the forms are surrendered back to the operator. The PTW is cancelled by the operator and the shift head informed and finally the Shift head gives feedback / fault related information to the Operations Manager who also keeps the GM in the loop. MV Engineering and Operations' Service Management process starts the fault removal process as soon as the complaint/fault information is received by the supervisor. The fault information can come from CSC or other departments. Request for isolation is submitted to HV operations manager, if needed. Additionally, complaints are raised by the monitoring teams who follow the approved annual maintenance chart. Monitoring officer(s) check if there is a genuine fault or not and updates the CMS accordingly if the call pertains to metering. The fault men/team visit the site and the team leader submits a report stating the fault identified and the material required to remove the fault. If the fault requires only replacement of defective materials, then a work order is generated and goes through the approval process followed by issuance of materials. Hexagon GIS is accessed to get the work order passed and also the geo codes updated/used. Finally, fault is removed and the complaint is closed. If the complaint is complex the Engineer develops a draft capital project proposal which follows the approval process. Upon receipt of the approval, projects and other processes are initiated. LV Service Management process starts the fault removal process as soon as the complaint/fault information is received by the supervisor. The fault information can come from CSC or other departments. Additionally, complaints are raised by the monitoring teams who follow the approved annual maintenance chart. Monitoring officer(s) check if there is a genuine fault or not and updates the CMS accordingly if the call pertains to metering. The fault men/team visit the site and the team leader submits a report stating the fault identified and the material required to remove the fault. If the fault requires only replacement of defective materials, then a work order is generated and goes through the approval process followed by issuance of materials. Hexagon GIS is accessed to get the work order passed and also the geo codes updated/used. Finally, fault is removed, and the complaint is closed. In the case if there is a fault due to customer, then there could be faults in the internal wiring of the premises for which the customer is advised to correct his wiring and what actions to take. Meter could have malfunctioned or burnt due to overload at the premises. The estimator prepares a quotation for new meter, which is approved by the LV management team and the commercial office informed. Data is taken from the faulty/burnt meter and entered into CMS. Afterwards a work order is generated, and Materials Management process is commenced too. If the complaint is complex the district engineer develops a draft capital project proposal which follows the approval process. Upon receipt of approval, the project is initiated. **Maintenance:** HV/MV/LV break down maintenance process starts when the fault comes in the notice of the on duty supervisor. The supervisor notifies and mobilises the appropriate fault removal team(s). He also informs the responsible (Maintenance) Manager about the outage in progress. Materials Management process is initiated if the fault team requires material to remove the fault. Upon successful removal / repair of the fault the supervisor arranges an engineer's inspection before the system can be brought online. If the inspection is not satisfactory then the fault team again works on correcting the mistake(s) in the light of directions given during the inspection. SCADA control is asked to close switches to restart power supply to the affected area. Permit to Work Closure is returned back to the issuer.

	Some faults can be temporarily fixed but the long term solution requires initiating a distribution improvement project. The engineer develops a draft capital project proposal which follows the approval process. Upon receipt of the approval, projects and other processes are initiated.
Goal	To keep the ECG network in good operational condition.
Assumptions	None
Interfaces	This process is required to interface with the following other processes: ▪ Field Service (CSC / Call Centre / Enquiries & Complaints / Complaints Resolution) ▪ Procurement process ▪ Materials Management process ▪ Approval process ▪ Capital Projects process ▪ Project Management System ▪ Financial Process
Components	Process is a component of the: ▪ Operations & Maintenance Process / EAM
Data Sources	None other than the module itself
Start Event (triggered by)	Complaints received from Customers via Customer Channelling / Call Centre / Field Service Complaints received via SCADA alerts

Inputs

Name	Source	Frequency	Volume	Media
New Service Connections	Customer Service Centre	Daily	300	Direct customer contact
Maintenance Inspections	Internal monitors	Weekly	5 per month per location	Allocated work order via Field Service

Outputs

Name	Source	Frequency	Volume	Media
work orders	Fault teams	5 per day per location	1,360 per annum	Mobile app
Proposals	Fault teams	1 per month per location	260 per annum	Paper and/or email
Project Costing	Management Accounting	daily	Big Data	ERP Mgmt Acc via posting against the actual asset or asset category

Reporting	Reporting requirements include: ▪ Maintaining an activity log for Workforce management ▪ Status reports on o internal technical team performance o sub-contractor performance vs employment of own teams o reaction time between start and resolution ▪ Workforce deployment
Complexity	Medium
Organisational or Process Alignment	The integration with Field Service / Workforce Planning might require some reallocation of staff and organisational restructuring coming with it. Additionally, there is the necessity to reorganise maintenance function to reduce the involvement of the number of process participants (see below roles involved).
Roles Involved	▪ Engineers ▪ Control Supervisor ▪ Shift Heads ▪ Mobile Teams ▪ Maintenance Supervisors ▪ Field Service and Workforce planning staff

2.6.3.1 Flow Diagram Process – Operations and Maintenance (Break-down)

Figure 28: Flow Diagram: Operations and Maintenance (Break-down)
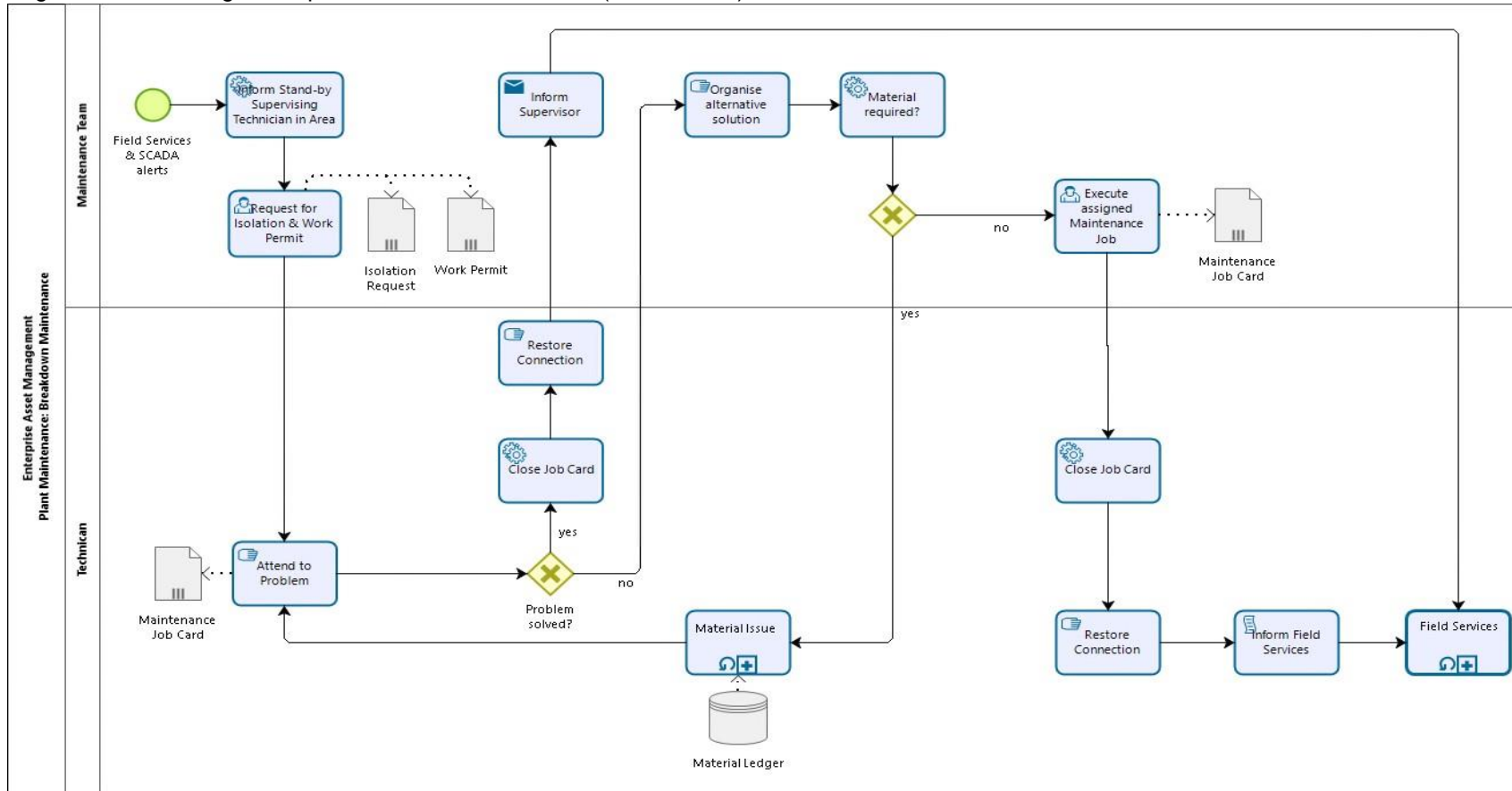
2.7 Engineering & Capital Projects

ECG Network expansion and building construction are done through Capital Projects. Projects are implemented when project proposals are approved. Technical designs are implemented to have an augmented power distribution system. Such projects are usually identified by field formations and Head Office also takes initiatives based on growth targets.

Descriptor	Details
Process Name	Project Proposals

Description	Capital Projects are initiated when Improvement New / Reinforcement / Expansion / Upgrading of Substations, Networks and Transformers etc. that are prepared by field formations are granted approval by the responsible ECG authority. Various distribution projects can also be identified together with or by Ministry of Energy and various clients. In certain cases, complex complaints are a result of weak network which requires enhancement / augmentation; this requires the operations / maintenance (fault) team leaders to also hold surveys that help in preparing design of these expansion projects.
	This is followed by development of Bill of Quantities (BoQs) / Material Schedule and Cost Estimates (MS&CEs) and drawings of the site, geographic coordinates and where the proposed material will get installed. An initial work breakdown structure together with time schedules are included in the proposal. All risks and planned risk responses are covered in the proposal. An outline giving risks and appropriate ways to avoid and/or mitigate them is part of the proposal.
	Based on this information the responsible operations engineers develop draft capital project proposals and submit them to the responsible managers for review and further processing. An outline of proposal is given below:
	1. Introduction
	2. Project purpose
	3. Business and project objectives
	4. Justification
	5. Scope of work and expectations
	6. Resources (Materials, Roles and Responsibilities)
	7. Assumptions and constraints
	8. Estimated Cost 9. Identified Risks
	10. Approvals
	The responsible operations managers direct the Project Engineers (PEs) to review the proposal and share their findings / comments / recommendations with them. PEs start the proposal review process by sending teams to inspect sites to verify that MS&CEs, other contents of the proposals and the accompanying drawings are factual and implementable. The team also verifies geographic coordinates of the location(s) / site with Hexagon GIS.

While all these engineering and project execution are organisationally handled differently in that they are executed by different organisational units they have from an administrative and costing point of view a lot of similarities, which requires an equivalent treatment in the ERP System. The sub-processes of capital projects are:

- Project Proposals

- Project Implementation

2.7.1   Project Proposals

Expansion projects first entry point is developing a proposal which goes through a cycle of refinement and then approvals based on threshold levels.

Table 32: Project Proposals

	Based on the teams' feedback and their own inspection PEs may amend the drawings by marking them, which get updated afterwards. Materials requirements are also reviewed and if needed quantities are adjusted, which result into new and updated MS&CEs. In this manner the Projects Engineers review and amend the draft project proposals and submit the revised ones to the review of the responsible managers who start the proposals review process. If the managers are satisfied with the quality of the proposals, then they make recommendations to the respective GMs for further processing; otherwise they are returned for corrections. PEs address the comments of the managers and re-submit updated / correct draft proposals for managers' review and approval. The managers submit the corrected draft proposals to the responsible General Managers for review and approval or endorsement to HQ for approval depending on the total cost worked out in the proposal and the ECG approved threshold limits. The GMs can either return the proposals back for getting clarification or approve them or submit them to the review and approval of the HQ. This must follow the threshold limits approved by ECG for all development projects. Upon receipt of approval Project Implementation process is initiated.
Goal	To extend ECG power distribution network and deliver projects within scope, time and budget.
Assumptions	There no assumptions in this process
Interfaces	Process interfaces with: ▪ System Design Process ▪ Approval Process ▪ Materials Management Process (historical information about materials and costs) ▪ Project Management process ▪ HR Management process - resource loading
Components	Process is a component of the: Capital Projects Process.
Data Sources	▪ Contracts ▪ Materials Management ▪ Human Resource System
Start Event (triggered by)	▪ Requirements identified with Region and Sub-T ▪ Projects of Government of Ghana (Ministry) ▪ Contracts provided by System Design

Inputs

Name	Source	Frequency	Volume	Media
Proposals - HV	Customer requests & internal findings for HV	3 per quarter per department	45 per annum	Paper and web
Proposals - MV	Customer requests & internal findings for MV	2 per month per department	192 per annum	Paper and web
Proposals - LV	Customer requests & internal findings for LV	2 per month per department	1920 per annum	Paper and web

Outputs

Name	Destination	Frequency	Volume	Media
Contracts - HV	Proposal submitting department	2 per quarter per department	33 per annum	Paper and email
Contracts - MV	Proposal submitting department	1.5 per month per department	140 per annum	Paper and email
Contracts - LV	Proposal submitting department	1.5 per month per department	1440 per annum	Paper and email

		Contracts – others	Proposal submitting department	2 per quarter per department	16 per annum	Paper and email	

		Provisional Project Costing	Time and attendance job Card	Regular	No. of proposals done per year	Posting against WIP to capitalised when the project is done or allocated to overheads if not done	
Reporting	- Weekly proposals outstanding - Project success rate - Time and cost analysis - Efficiency ratings & exception reporting						
Complexity	Low from an ERP point of view						
Organisational or Process Alignment	A consolidation of the different faculties and/or system planning could be beneficial, in order not to lose sense of reality.						
Roles Involved	The composition of the project proposal and approval process is dependent on thresholds levels and determines the approving parties, which will vary but can included the following roles and need to be established in the ERP System with the corresponding user rights: - Board of Directors - Managing Director - Deputy Managing Director - Directors - General Managers - Operations Manager - Engineering Managers - Maintenance Managers - Electrical Engineers - Civil Engineers						

2.7.1.1   Flow Diagram Process – Project Proposals

Figure 29: Flow Diagram: Project Proposals
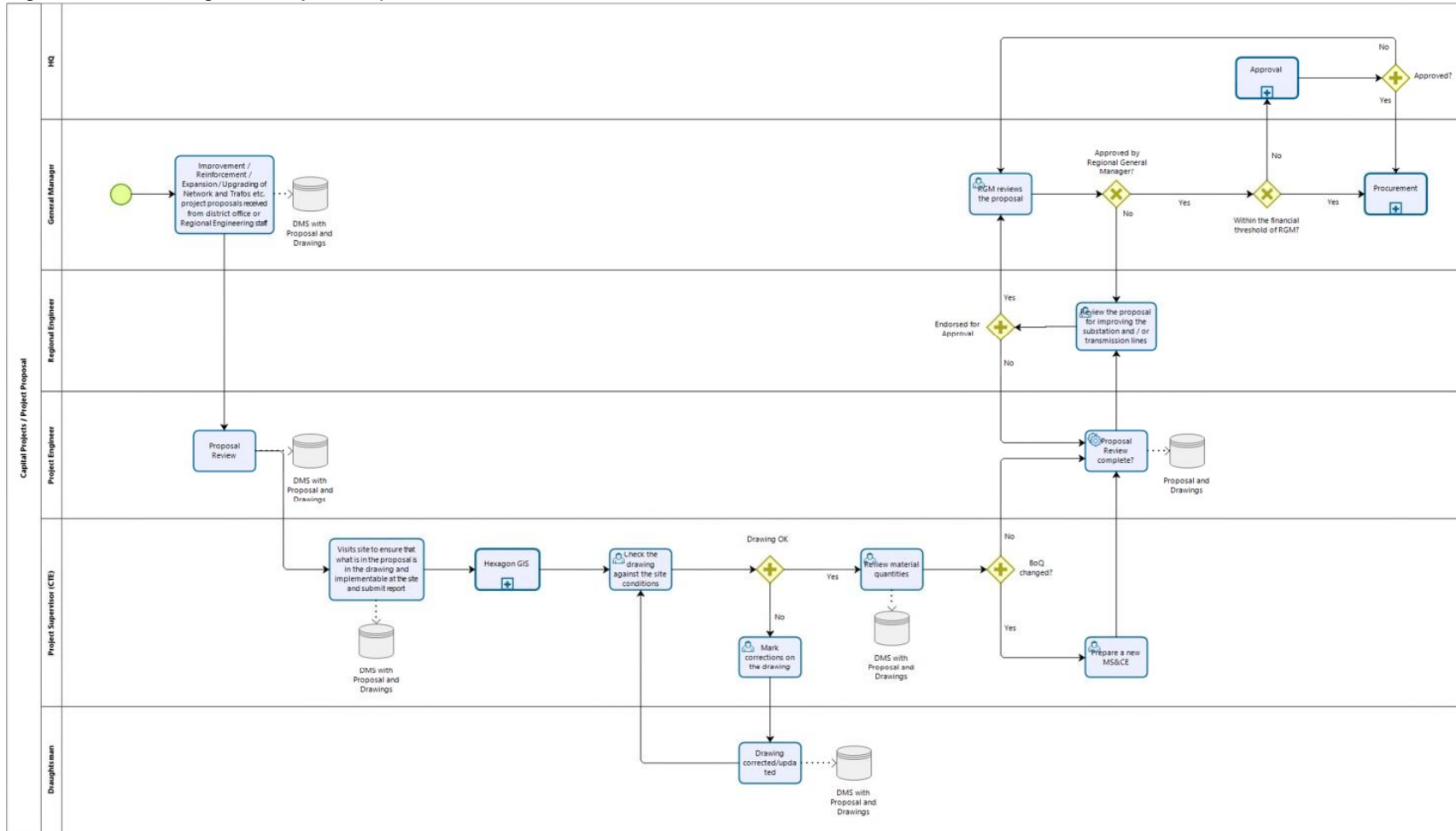
2.7.2 Project Implementation

The aim is to successfully deliver all ECG or donor projects within time and budget. A greater focus on project implementation will assist achieve this objective.

Table 33: Project Implementation

Descriptor	Details
Process Name	Project Implementation
Description	The implementation of electric distribution and / or construction projects (Premises Division) is set up when the project proposal owners receive projects approval from the responsible ECG authority. The first activity is to develop ToRs / RFP / Tenders and start the Procurement process to hire contractors. In parallel, the project is setup in the Project Management System for tracking and reporting purposes.
	Projects that belong to the Ministry of Energy projects are contracted by the ministry directly and handed over to ECG for implementation, while projects contracted by Engineering are directly handed over to the ECG projects office for implementation. All projects' documentation and agreements are available in the document management system with appropriate notifications / alarms configured. For projects initiated by ECG contractors are hired through the procurement process.
	ECG projects team mobilises contractor(s) to start work on expansion projects implementation. For ECG projects the contractor picks up materials from ECG Main Depot and other stores. While for all other types of projects it is the responsibility of the contractor to supply materials. Contractors may be provided with materials from Main Depot at Tema to meet any adhoc / emergent requirements which will later either be adjusted by making deductions from contractors running payments or by returning similar material back to the Depot.
	This starts the onsite building construction and equipment installation works. In parallel to this Project Management process is also invoked. As and when agreed project milestones are achieved contractor(s) submit invoices for payment. Contractors are required to submit invoices to the responsible Project Manager(s) verification and release of payments. The submitted invoices are verified by the respective project teams and further processed for payment; otherwise they are kept pending. Projects stakeholders teams visit construction sites and obtain As-Built site measurements and then check the invoice against these measurements. For releasing final payment, first pre-commissioning tests are done in the presence of all stakeholders which are defined in the Project Management System uniquely for all projects. If tests are not successful the ECG team identifies all non-conformances and asks the contractor to rectify them within a fixed time duration. In the case pre-commissioning tests are successful the following gets done:
	▪ Obtain As-Built drawings from contractor(s)
	▪ Issue interim takeover certificate
	▪ Physical completion report prepared
	With this the project is capitalised and becomes part of ECG's asset base.
	Contractor(s) final invoice is processed for release of payment. However, retention money is deducted from the final invoice and every preceding payment. When the defect liability period is successfully over ECG issues a final take over certificate to the contractor(s) after which the request for release of retention money is processed and contractor(s) final liability is settled.
Goal	To extend ECG power distribution network and deliver projects within scope, time and budget.
Assumptions	There no assumptions in this process
Interfaces	Process interfaces with:
▪ Project Management process
▪ System Design Process
▪ Approval Process
▪ Materials Management Process
▪ Financial (AP) process
▪ HR Management process
Components	Process is a component of the: Capital Projects Process.
Data Sources	▪ Contracts
▪ Materials Management
▪ Human Resource System
Start Event (triggered by)	▪ Requirements identified with Region and Sub-T
▪ Projects of Government of Ghana (Ministry)
▪ Contracts provided by System Design

Inputs		Name	Source	Frequency	Volume	Media	

	Contracts	Relevant ECG department	15 per month per department	1629 per annum	Paper and web
	Project Costing	Service Order / Job Card System	daily	Big Data	Digital Data external App
Outputs	**Name**	**Destination**	**Frequency**	**Volume**	**Media**
	Material is issued	Requestor of material	300 items per day	90 per month	Paper and email
	Invoices processed	Contractor	250 per month	3000 per annum	Paper and email
	Project Costing	Management Accounting	daily	Big Data	Posting against the actual project to be capitalised

Reporting	- Monthly project status reports - Project success rate - Time and cost analysis - Efficiency ratings & exception reporting
Complexity	Medium from an ERP point of view.
Organisational or Process Alignment	A consolidation of the different faculties and/or system planning could be beneficial, in order not to lose sense of reality. There is certainly a necessity to reorganise the execution of capital projects to reduce the involvement of the number of process participants (see below roles involved).
Roles Involved	- General Managers - Project Engineers - Civil Engineers - Manager Supplies - Procurement Manager - Stores Officer - End users

2.7.2.1   Flow Diagram Process – Project Implementation

Figure 30: Flow Diagram: Project Implementation
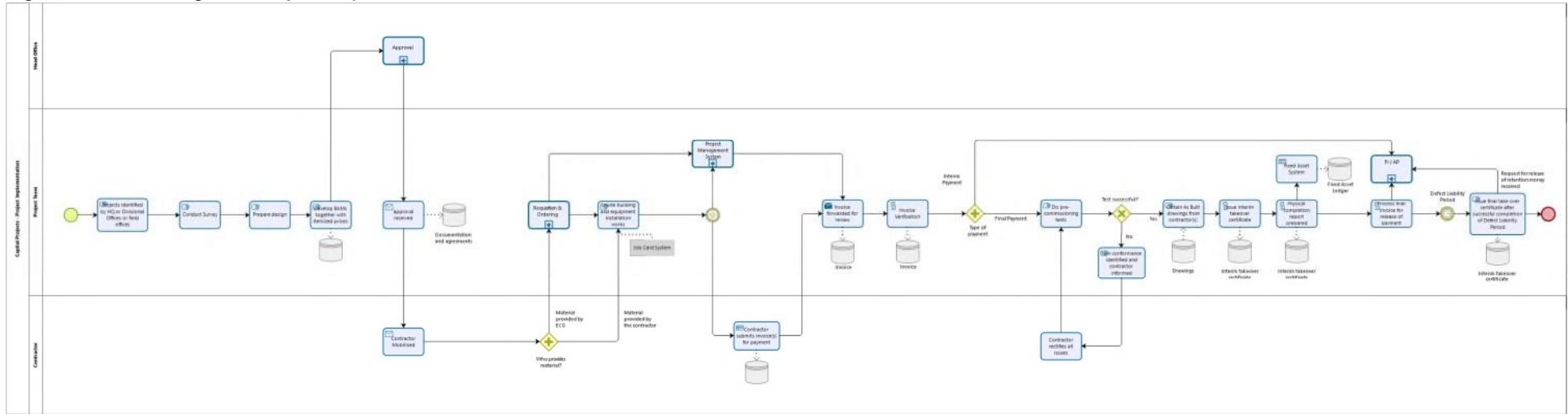
2.7.2.2   Registration of Contractors

This process has been consolidated into one subprocess combining and streamlining the registration and approval of any type of supplier of goods and services, contractors as well as pre-paid vendors who want to do business with ECG under the same harmonised conditions. This process pertains to:

- Supplier/Vendor Registration

- Pre-paid Vendor Registration

- Registration of Contractors

For more details see point 2.1.2.

2.7.3   Premises

Premises is responsible for all developing designs, BoQs for all civil works within ECG. It also reviews designs of tower lines, pylons and their foundations which are developed by selected contractors. Premises also provides recommendation to Design Division on the civil engineering side of works.

Table 34: Premises

Descriptor	Details
Process Name	Premises
Description	Premises develops designs for buildings (sub-stations, houses and office buildings) and for foundations of tower lines / pylons. It also develops Terms of Reference / Scope for Civil Works for them. Further, Premises also reviews all contractor's submittals pertaining to the preceding areas and gives feedback on them.
	It also implements projects for office building construction and large renovations for which it develops project proposals. Upon getting the proposals approved Premises initiates procurement processes and gets the most qualified contractor hired for the project in hand. It sets up the project in the Project Management System for tracking and reporting purposes. All projects' documentation and agreements are available in the document management system with appropriate notifications / alarms configured. For projects initiated by ECG contractors are hired through the Procurement process.
	In the case of premises projects, it is the responsibility of the contractors to supply materials.
	This starts the onsite building construction works. As and when agreed project milestones are achieved contractor(s) submit invoices for payment. Contractors are required to submit invoices to the responsible Project Manager(s) for verification and release of payments. The submitted invoices are verified by the respective projects teams and further processed for payment otherwise they are kept pending. Projects stakeholders' teams visit construction sites and obtain As-Built site measurements and then checks the invoice against these measurements. For releasing final payment, first pre-commissioning tests are done in the presence of all stakeholders which are defined in the Project Management System uniquely for all projects. If tests are not successful, the ECG team identifies all non-conformances and asks the contractor to rectify them within a fixed time duration. In the case pre-commissioning tests are successful the following gets done: ▪ Obtain As-Built drawings from contractor(s)
	▪ Issue interim takeover certificate
	▪ Physical completion report prepared
	With this the project is capitalised and becomes part of ECG's asset base.
	Contractor(s) final invoice is processed for release of payment. However, retention money is deducted from the final invoice and every preceding payment. When the defect liability period is successfully over ECG issues a final take over certificate to the contractor(s) after which the request for release of retention money is processed and contractor(s) final liability is settled.
Goal	To design and construct purpose-built spaces for ECG use cases.

Assumptions	There no assumptions in this process					
Interfaces	Process interfaces with: ▪ Approval process ▪ Procurement process ▪ Project Management System ▪ Capital Projects					
Components	Process is a component of the: ▪ Premises process					
Data Sources	▪ HQ directions ▪ Contracts ▪ Contractor submittals					
Start Event (triggered by)	Head Quarter expansion plans Requests received from other departments					
Inputs		**Name**	**Source**	**Frequency**	**Volume**	**Media**	
		Data still missing from ECG					
Outputs		**Name**	**Destination**	**Frequency**	**Volume**	**Media**	
		Data still missing from ECG					
Reporting	▪ Monthly project status reports ▪ Architectural and structural designs developed ▪ Monthly project status reporting ▪ Project Success rate ▪ Time and Cost Analysis ▪ Efficiency ratings & exception reporting					
Complexity	Low					
Organisational or Process Alignment	Taking note of the fact the premises department mainly consists of civil engineers, it remains the question whether their participation in the design of projects necessarily requires a separate organisational unit or if ECG is better serviced to dissolve the separation by integrating the structural and civil engineering into the project capital works units and combine the project management under one responsibility.					
Roles Involved	▪ General Manager ▪ Managers ▪ Architects ▪ Structural Engineers					

2.7.3.1   Flow Diagram Process – Premises

Figure 31: Flow Diagram: Premises
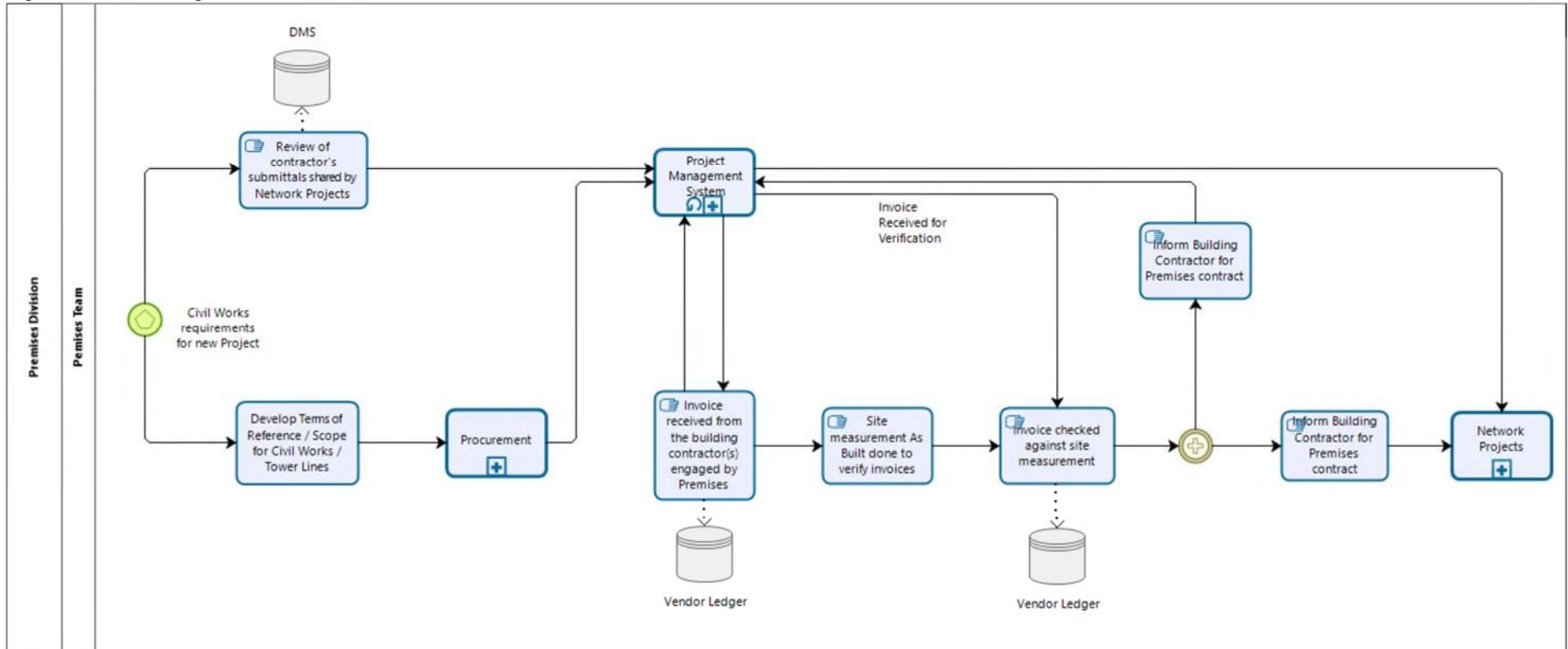
2.8   Human Capital Management (HCM)

The HCM processes manage all functions from hiring an employee to its final termination in an organization. It usually consists of two distinct parts:

1)   Human Resources Administration

2)   Human Resources Performance Management The

   differences are the following:

▪ Human Resources Administration:

   o Capacity Planning o Staff

   Selection & Recruitment o On

   boarding o Payroll o Leave &

   Vacations o HR Termination

▪ Human Resources Performance
   Management:

   o Planning Budget & Personnel Cost Management

   o Personnel Development o Training & Event

   Management o Benefits & Compensation o

   Organizational Management o Travel Management

A very important aspect should not be overlooked, while ECG keeps performance KPIs, actual Personnel Development and any form of performance-related benefits could not be identified. Such performance management in HCM is of importance for any form of further development of the organisation and its staff.

The introduction of an ERP system, which is per definition combined with some form of organisational or process alignment, is an excellent opportunity to consider staff development.

Even though the part HR performance management will be included in the functional requirements, the starting point for the implementation will concentrate on the HR Administration processes.

2.8.1   Capacity Planning

This process monitors not only time and attendance but also serves as the underlying data repository for staff requirements in the various organisational units. The process and the data produced need to be treated with care, when the organisational- or process alignments are taking place with the implementation of the ERP system.

Table 35: Capacity Planning

Descriptor	Details
Process Name	Capacity Planning

Description	The business process describes
	▪ How to manage staff attendance and
	▪ How to utilise the derived data to do capacity planning for the various departments.
Goal	This process has three objectives:
	1. To ensure that time and attendance is monitored and recorded in the payroll system for amongst others overtime payments.
	2. To ensure that enough staff capacity is available in the various organisational units as per approved staff positions.
	3. To ensure that staff is on time for daily duties or better be present at all.
Assumptions	The as-is process is usually subject to flaws, because no proper attendance system is in place and given the amount of staff to be controlled and evaluated makes the process very cumbersome.
	Thus, is it assumed that a proper clocking system automates and supports the time and attendance recording and supports capacity planning.
Interfaces	An interface is required for the clocking system to be selected, otherwise the process interfaces with
	▪ HR Administration process
	▪ Annual Budgeting process
	▪ Field Service and workflow management
	▪ Financial Management process
Components	The three components of this process are
	▪ Time and attendance
	▪ Capacity evaluation per organisational unit
	▪ Disciplinary action to be taken in case of repeated not attendance
	▪ integration with Field Service and workforce management
Data Sources	The data are delivered via the time tracking system
Start Event (triggered by)	Daily working hours
Inputs	Typical inputs include the time tracking data from the clocking system as well as evaluation routines:

Name	Source	Frequency	Volume	Media
Time and attendance	Clocking system	Daily	2 x 6800 times	Digital time stamps in/out

Outputs	Examples of outputs include: products, services, reports, information, and paperwork. For example:
	▪ Attendance Report
	▪ Exception Report
	▪ Non-compliance events

Name	Destination	Frequency	Volume	Media
Time & attendance	Payroll	Daily	2 x 6800 times	Digital time stamps in/out
Staff audit	HR Audit Section	Daily	2 x 6800 times	Digital time stamps in/out
Disciplinary action	Manager of Organisational Unit	Monthly	Exception report	Digital report

	Name	Destination	Frequency	Volume	Media	
	Workforce management	Management accounting	Daily	6800 times	Staff utilisation report from ERP system	
	Project Costing	Management Accounting	daily	Big Data	Posting against the actual asset or asset category or projects	

Reporting	The following reports are associated with the performance of the staff. These reporting requirements can include: ▪ Maintaining an activity log ▪ Weekly / monthly attendance reports ▪ Staff utilisation report ▪ Cost Centre and Cost Object reporting ▪ Exception reports ▪ Capacity comparison reports ▪ Disciplinary action reports
Complexity	Medium
Organisational or Process Alignment	The process can be centralised, and a reduction of staff involved can be envisaged, if a time and attendance system is installed. All reporting will be automated.
Roles Involved	Employees, central HR officers

2.8.1.1 Flow Diagram Process – Capacity Planning

Figure 32: Flow Diagram: Capacity Planning
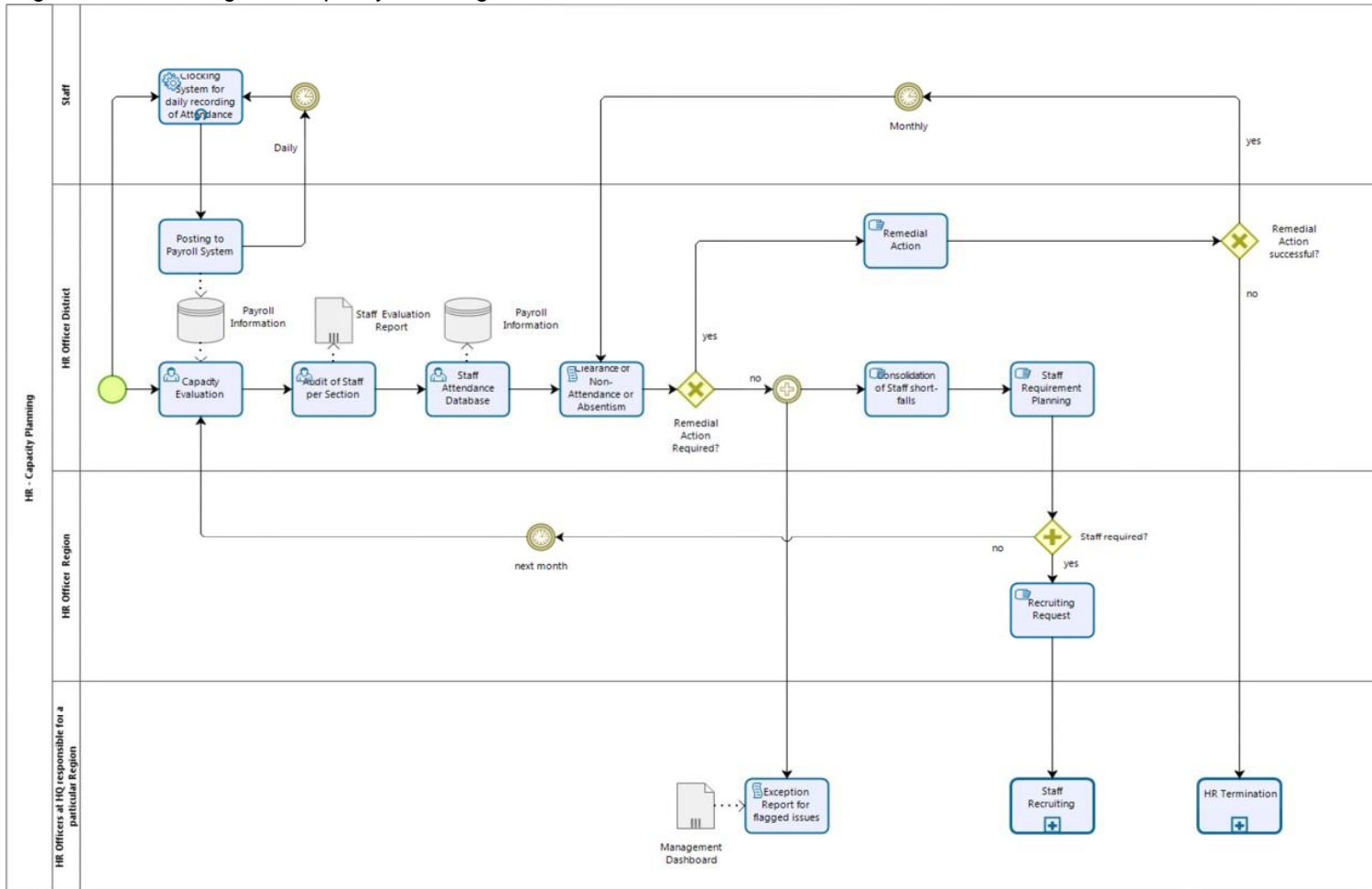
2.8.2 Staff Selection & Recruitment

Besides the fact that potential new staff should be recorded even though they might not have been successful this process mainly takes place outside of the ERP system; it only starts once staff is selected for employment.

Table 36: Staff Selection and Recruitment

Descriptor	Details
Process Name	Staff Selection and Recruitment
Description	The process uses the output of the Capacity Planning process (see point 2.8.1) as input for the recruitment process to do as the name says staff recruitment. The process is mainly manual and consists of a panel to do the selection and interviews with various short-listed candidates The process ends with a score sheet and a recommendation to recruit a particular candidate to receive a job offer.
Goal	The objective of the process is to select staff for ECG from either internal or external sources.
Assumptions	The process is mainly a manual process which can only be automated to a very limited extend by keeping records of applicant in the HR system for future utilisation.
Interfaces	Process interfaces with: the Capacity Planning (see point 2.8.1) process.
Components	The Process is a component of the: general recruitment process.
Data Sources	Capacity Planning data, staff information from the training centre as well as external applications play a role in this process.
Start Event (triggered by)	The process is triggered by a staff requirement.
Inputs	Typical inputs include: ▪ Time & attendance data ▪ Staff information from training centre ▪ External applications _see table below_
Outputs	Examples of outputs include for example: ▪ Interview reports ▪ Minutes of interviews ▪ Staff recommendations _see table below_
Reporting	It can also include the formal notification of an activity state, event or milestone to management and peers, including details of: ▪ Who was interviewed ▪ Minutes of the panel ▪ Recommendation with motivation ▪ Job offer to be dispatched
Complexity	Low
Organisational or Process Alignment	The process needs to be more decentralised and authorities need to be delegated to the potential staff recipient for him/her to decide whether or not s/he requires staff or position to be filled. Remuneration should not be coupled to the number of staff but to the results achieved.
Roles Involved	HR staff plus receiving organisational units

Inputs table:

Name	Source	Frequency	Volume	Media
Capacity Planning data	Time & attendance data	On demand	Not known	Digital information
Application data	Staff in training Ext. applications	On demand	Not known	Digital information
Job interview panel	Record on staff interviews	On demand	Not known	Digital information from DMS

Outputs table:

Name	Destination	Frequency	Volume	Media
Staff recommendation	HR for hiring	On demand	Not known	Job offer via email and/or paper

2.8.2.1   Flow Diagram Process – Staff Selection and Recruitment

Figure 33: Flow Diagram: Staff Selection and Recruitment
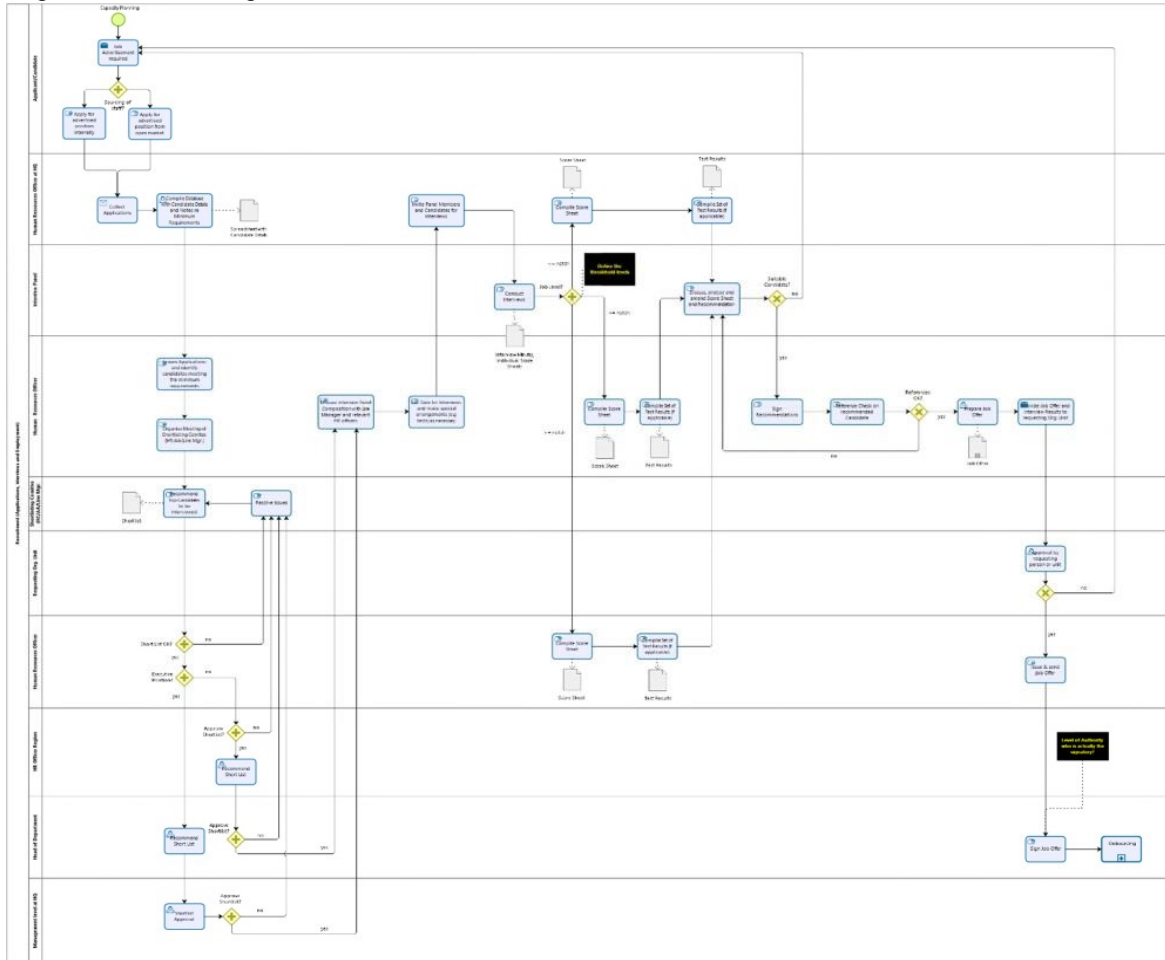
2.8.3   Onboarding

When the selected interviewee accepts and returns the signed job offer. The process takes care of all the administrative aspects of the new employee regarding ECG's employment conditions and legal requirements before the new staff member is effectively recognised as a staff member.

Table 37: Onboarding

Descriptor	Details
Process Name	Onboarding
Description	The process starts with the issuance of a job offer signed by the HR Officer and the receiving head of department. If the job offer is not accepted, it goes back to recruitment. If the offer is however accepted the actual on-boarding process is initiated with informing all relevant parties of the "new arrival". Capture candidate's documents and forms are prepared as there are: Social Admission, Pension Admission, Medical Aid Admission, Post-Employment Form, Income Tax Certificate Details, and Contract etc. A draft personnel file (master data) is created and submitted for approval to the payroll unit. An induction is prepared and executed after which the personnel master file (data) are verified and switched live.
Goal	The objective of the process is to introduce a new staff member to ECG and open a personnel master file for payroll to take place.
Assumptions	No further assumption
Interfaces	No interface other than to the HCM system of the ERP
Components	Process is a component of the: ▪ Recruiting process and subsequently of the ▪ Payroll Process
Data Sources	Manual data from the staff recruiting process like personnel information, recruitment recommendations, etc.
Start Event (triggered by)	The trigger of this process is the request for on-boarding by a department head after the staff selection process.
Inputs	Typical inputs include the information about the staff including ▪ Interview minutes ▪ Score sheet information ▪ Recommendation to hire | Name	Source	Frequency	Volume	Media
---	---	---	---	---
Staff information	Training Centre or external application	On demand	Not known	Manual data	

Outputs	The output of this process is the
	▪ Employee master file with all relevant information about
	   o Social admission o Pension Admission o
	      Medical Aid Admission o Post-Employment
	Form o Income Tax Certificate Details o
	      Contract etc.
	
	| Name
		Destination	Frequency	Volume	Media

---	---	---	---	---
Employee Information	Master File	On demand	Not known	ERP Master File
Employee Master File	Payroll	On demand	Not known	ERP Master File	

Reporting	Reporting requirements can include:
	▪ Maintaining an activity log
	▪ Weekly status reports
	▪ Activity events and milestones

	▪ Individuals who receive the report
Complexity	Medium
Organisational or Process Alignment	none
Roles Involved	HR Officers at HQ

2.8.3.1 Flow Diagram Process – Onboarding

Figure 34: Flow Diagram: Onboarding
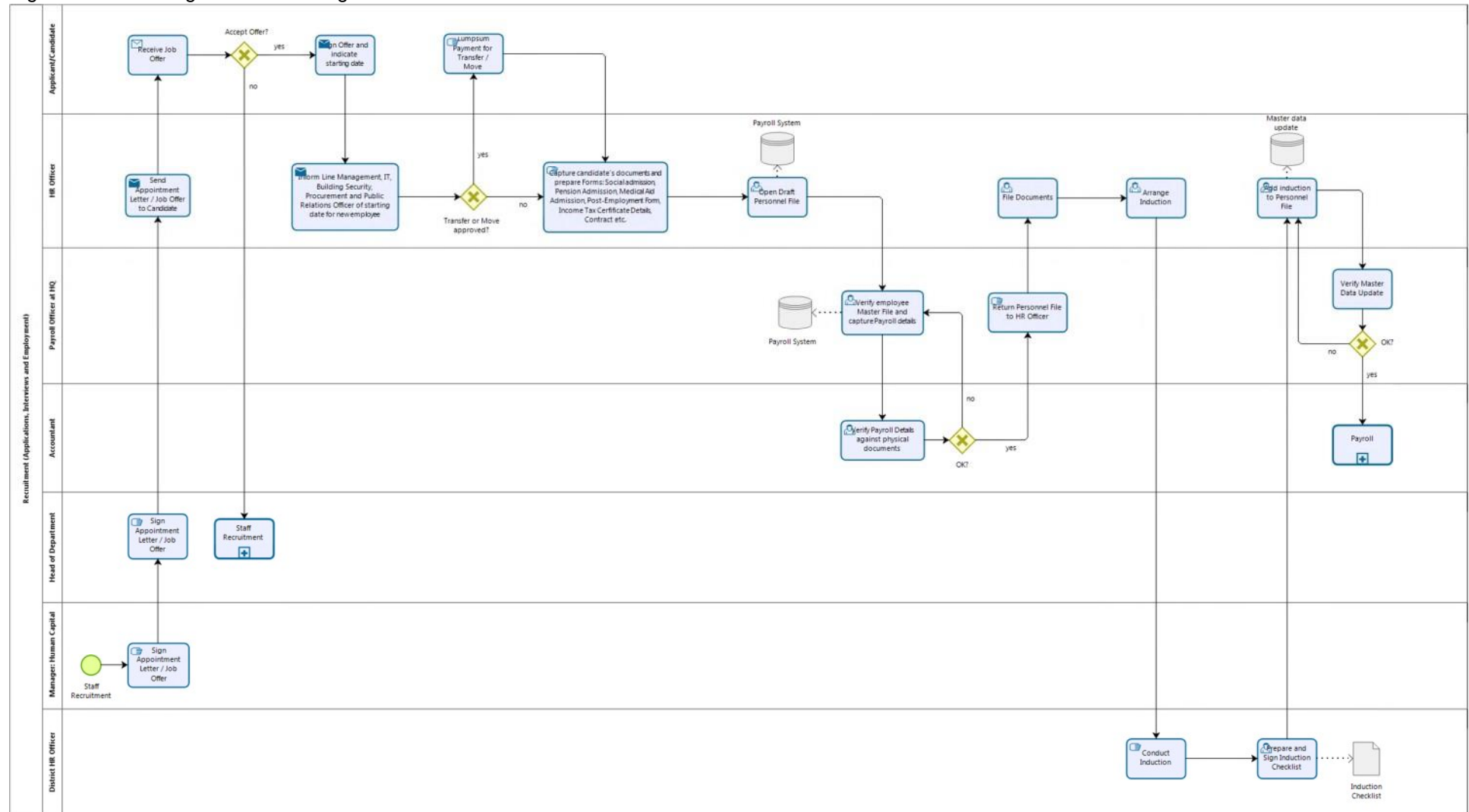
2.8.4   Payroll

This process deals with payments to employees on a monthly basis.

Table 38: Payroll

Descriptor	Details
Process Name	Payroll
Description	Payroll process describes how to prepare and execute the monthly payroll to all ECG employees.
Goal	The payroll process starts with the collection of all relevant information that pertains to the payroll to be executed at month end, i.e. ▪ Basic salary ▪ Information about overtime ▪ Information on Allowances ▪ Deductions ▪ Loans ▪ Subscription ▪ New/Updated/Terminated Contracts amendments Such information is then verified and combined with overtime delivered per month. All information is verified with a 4-eye principle before payment is released. The payments are released via ACB file to the main bank for further processing. The pay slips are provided to employees and the G/L is updated, which ends the process until the next pay run.
Assumptions	The pay run is executed electronically either via ACB files or direct electronic payment.
Interfaces	ACB file for pay run transfer to the bank.
Components	Process is a component of the general monthly payroll process which succeeds the on-boarding process.
Data Sources	Data from social security et.al. Overtime data from the time & attendance system
Start Event (triggered by)	Monthly pay run
Inputs	Typical inputs include: ▪ Basic salary information ▪ Information about overtime ▪ Information on Allowances ▪ Deductions, Loans, Subscription ▪ Contracts amendments **Name** / **Source** / **Frequency** / **Volume** / **Media** Salary information / Personnel master data / Monthly / 6800 / Digital data from ERP System
Outputs	Outputs include combined payment information summarised form the above inputs **Name** / **Destination** / **Frequency** / **Volume** / **Media** Payroll information per employee / Pay run / Monthly / 6800 / Digital information Pay run / ACB file for bank / Monthly / 6800 / Digital information
Reporting	These reporting requirements can include: ▪ Maintaining an activity log ▪ Monthly payment reports
Complexity	Medium
Organisational or Process Alignment	None required
Roles Involved	HR department, HR Officer, Payroll Officer, 1st and 2nd signatory as per threshold

2.8.4.1 Flow Diagram Process – Payroll

Figure 35: Flow Diagram: Payroll
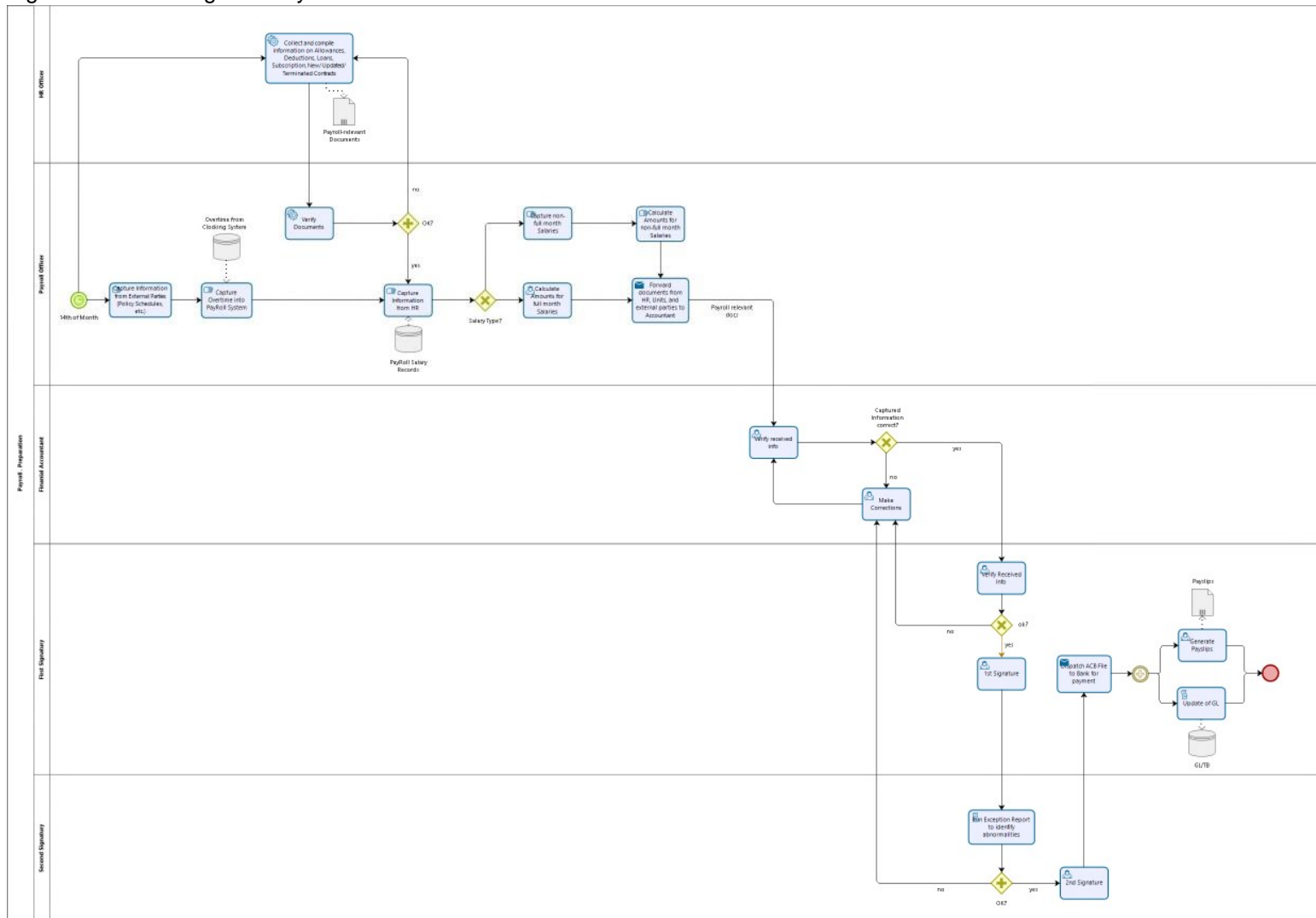
2.8.5 Leave & Vacations

ECG establishes an annual leave roster and maintains a certain compliance of timing, without necessary losing the flexibility of allowing also authorised ad-hoc leaves. The process deals the overall leave and vacation environment and its approvals.

Table 39: Leave & Vacations

Descriptor	Details
Process Name	Leave and Vacations
Description	The process aims at establishing a leave roster per organisational unit for the year and administer the applications for leave along the planned routine as well as along the ad-hoc lines. A leave roster itself requires the approval of the direct senior of the applicant as well as his senior to take effect. Also, the leave application itself requires the approval from both the direct senior and its senior. In case the application is declined the employee is informed accordingly. In case of approval the leave record is updated, and the employee is "granted" leave.
Goal	The process aims at coordinating leave of staff with the ongoing work activities, which can result in a leave decline even though it is planned during the annual roster establishment.
Assumptions	The underlying principles of the leave application process are: ▪ The leave roster and register are maintained as part of the ERP HCM System ▪ A proper leave roster is available indicating the implications of the leave to be taken during certain periods of the year ▪ The leave roster also enables leave on an ad-hoc basis ▪ The process ensures that the organization is not handicapped by the leave of its staff ▪ The process does not conflict or undermine any other internal processes
Interfaces	Process interfaces with the employee master files as part of the HR Process.
Components	Process is a component of the overall HR Process.
Data Sources	Manual update of the master files via a self-service module of the ERP System.
Start Event (triggered by)	The process is triggered on an annual basis and updated on an as and when required basis.
Inputs	Typical inputs include the utilisation of the employee self-service to update the leave roster. | Name	Source	Frequency	Volume	Media
---	---	---	---	---
Leave roster	Annual update of employee leave requirements	Annual	6800	Manual data input on a selfservice module	
Outputs	The outputs include the consolidated leave requirements per organisational unit: | Name	Destination	Frequency	Volume	Media
---	---	---	---	---
Input in leave roster	Leave requirement update per organisational unit	Annual	6800	Digital information about leave frequency per org unit
Workforce management	Leave monitoring	Annual	6800	Digital information about leave taken and staff on leave	
Reporting	The reporting requirements can include: ▪ Maintaining an activity log ▪ General leave roster per organisational unit ▪ Combined, consolidated leave roster ▪ Weekly status reports on leave taken ▪ Status report on outstanding leave
Complexity	Medium
Organisational or Process Alignment	None required
Roles Involved	Two seniors of the employee and the employee him/herself

2.8.5.1 Flow Diagram Process – Leave & Vacations

Figure 36: Flow Diagram: Leave & Vacations
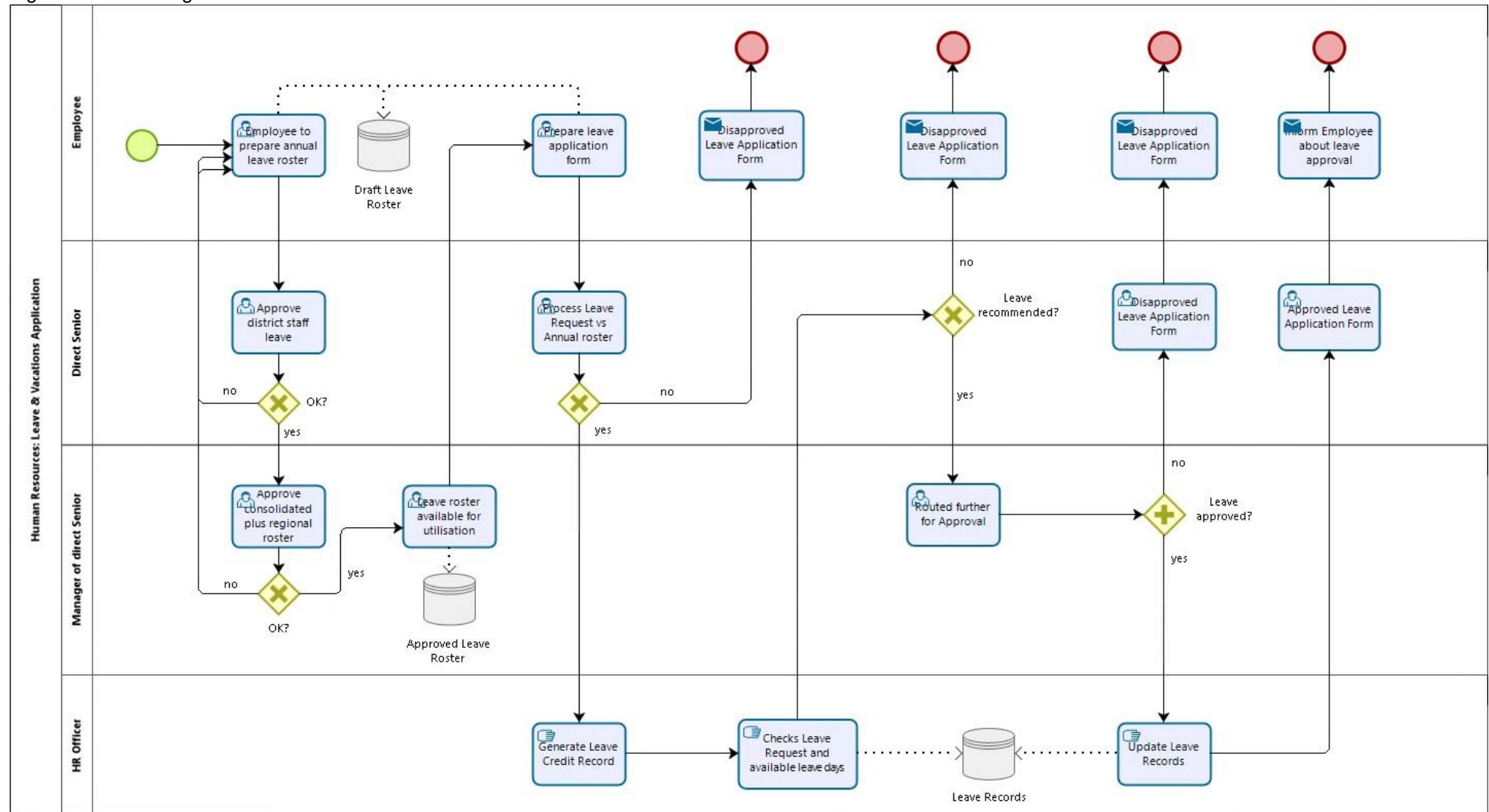
2.8.6   HR Termination

The process deals with the termination of employment for ECG's staff establishment for various reasons.

Table 40: HR Termination

Descriptor	Details
Process Name	HR Termination
Description	The HR Termination process describes how the termination of employment is handled within ECG. The process can have two possible initiation points: 1. Tendered Resignation / Retirement / Death 2. Termination due to disciplinary action
Goal	The objective of the process is the correct termination of employment with ECG It ensures that: ▪ In terms of an ordinary termination all pay-outs are appropriately calculated and paid out to the resigning employee ▪ In terms of death all remaining salaries, social benefit are correctly calculated and paid out to the bereaved. ▪ All terminated employees receive their remaining salaries and what is legally due to them ▪ The pay-roll is amended accordingly to avoid "shadow employees"
Assumptions	The only valid assumption is that employees are handled with the existing pay-roll and HCM system of the ERP and nobody and no records are carried outside of the system. This can be avoided by exclusively paying according to the pay-roll records and to undermine any other internal processes.
Interfaces	The interface is the self-service module of the HCM and the pay-roll system together with the employee master data.
Components	Process is one of the components of the HCM system.
Data Sources	Employee master record coined with the benefit statements of any third-party provider, e.g. social security, pension funds etc.
Start Event (triggered by)	The process is triggered by a resigning or deceased employee.
Inputs	Typical inputs include: benefit data by third parties. For example: ▪ Pension funds ▪ Life insurance ▪ Health care

Name	Source	Frequency	Volume	Media
Date of termination	Written record	Not known	Not known	Manual data or employee selfservice

Outputs	

Name	Destination	Frequency	Volume	Media
Benefit pay-out calculation	Employee or bereaved	Not known	Not known	Benefit calculation record
Benefits Pay-out	Employee or bereaved	Not known	Not known	ACB File or single payment advise

Reporting	Reporting requirements associated with the HR-termination process should include: ▪ Activity events and milestones o Individuals who received the records o Benefit statement o Date, time and amount of pay-out o Record of updating the personnel record o Closure of file
Complexity	Low
Organisational or Process Alignment	none
Roles Involved	HR Officer, direct senior, supervisor, 1st and 2nd signatory, employee or bereaved

2.8.6.1   Flow Diagram Process – HR Termination

Figure 37: Flow Diagram: HR Termination
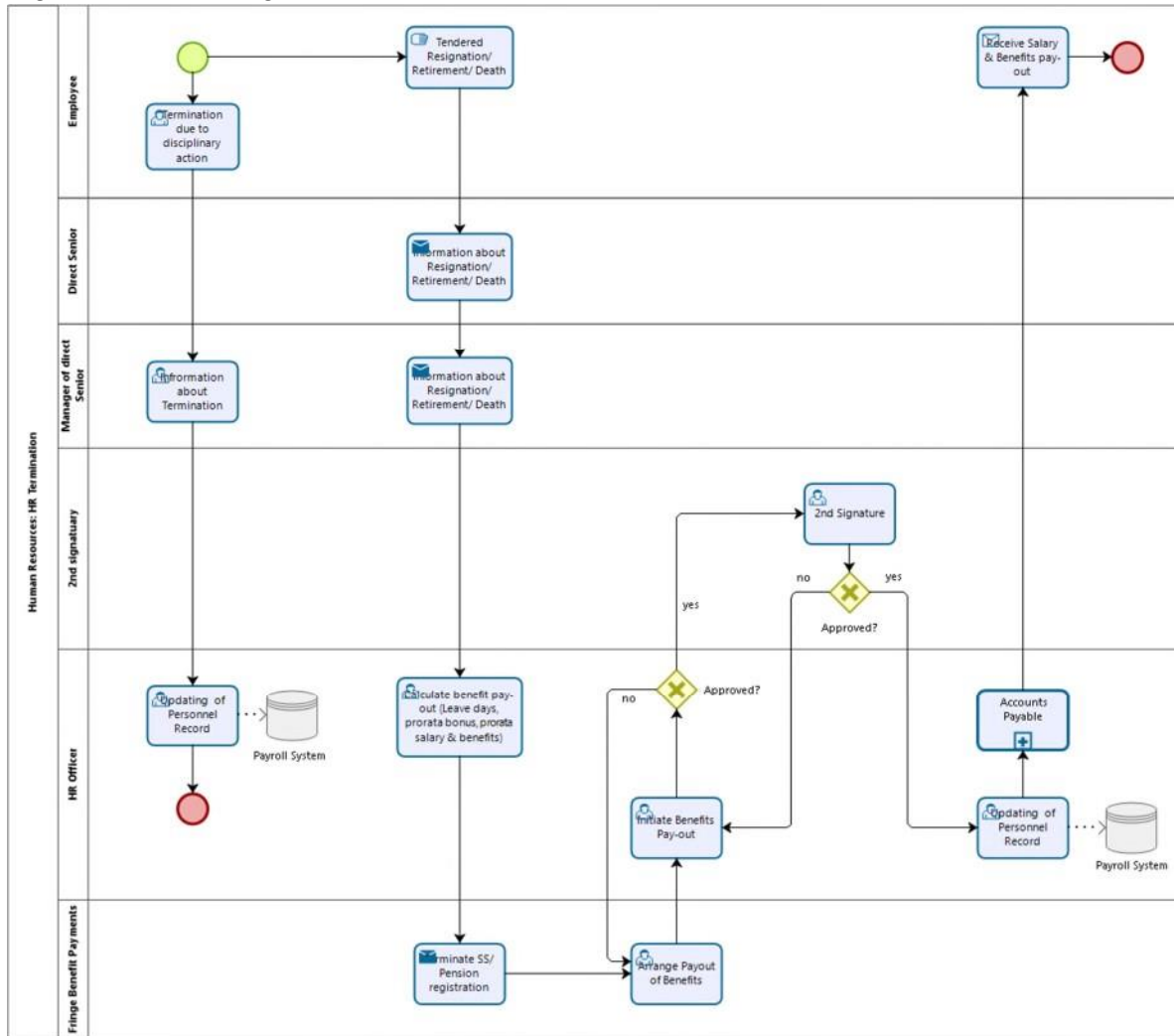
ERP Training Program

Development of ERP System for PDS – a MiDA Ghana Project

Additional Information in Support of the IFB v1.0
Submitted on 29 July 2019

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1.   People to be Trained

Note to Bidder: *this document is additional information only and presents the holistic approach to the ERP project and incorporates Core and Optional Requirements. Please adhere to the definitions in the IFB.*

Eventually all PDS staff who will be users of the ERP system in whatever capacity will receive training. It is expected up to 4500 people will be trained in the use of various modules, while some of them will be required to attend sessions for multiple modules.

Training should be planned for five categories of PDS staff as given below:

1. Executive Management
2. Directors (Heads of Departments)
3. General Managers (Divisional Managers)
4. Managers (Sectional & Unit Managers)
5. Senior Staff (including supervisory staff)

Whilst we assume that most of the Executive Management and Directors have functional computer operations experience, it would be necessary to undertake some basic computer literacy enhancement programme for them to further sharpen their orientation towards the upcoming new systems, especially in the respect of transaction approvals online. Similarly, the GMs and Managers would be taken from intermediate level to advanced users training given the oversight responsibility they are expected to have over their functional unit operations in the post-ERP implementation period. Staff will have a varying level of exposure to IT Systems depending on their expected usage exposure in the new systems.

A prospective list of PDS personnel including Executive Management who would be receiving training on the various modules of ERP is provided in Annex 1.

A point to note is that training within topics would be progressive based on experience and role, but also – where possible – based on an assessment of capabilities.

1.1   Training Method

The following training methodologies will be employed to conduct actual training:

- General Overview over the chosen ERP System.
- On the Job Training (OJT) for existing users. New employees would also benefit from this.
- Table top discussions and job/task/activity walks.
- Formal training: classroom sessions (conducted on or off site).

Since ERP systems are large, complex integrated software applications implementation often takes from months up to a few years. The most successful ERP training programs follow a traditional classroom training format conducted in a setting with an instructor and reference

materials. A general overview and introduction of the chosen ERP is expected to be provided at the start of any new training session which will also include various types of operational demonstrations.

It is expected that OJT will be performed in the Electro-Volta House (Headquarters building in Accra) and in such other locations as would be convenient for project delivery effectiveness.

1.2   Qualification Method

Once training has been completed, the mastery of each trainee must be measured to determine how well the trainee has mastered the material presented in the training. Vendors are required to propose all such measurement techniques. We stress that for the purposes of ERP implementation in PDS, the quality of these measurements is just as important as the quality of the training materials themselves.

HR performance management is often mentioned in the PDS organisation, while in fact, no fully maintained and established HR system to track staff performance is in use. That means that no course exams or tests are implemented, and no real evaluation takes place and staff is currently sent back to their duty station, regardless of their accomplishments.

1.3   Training Schedule

Training of designated PDS staff members would need to be planned in a manner that PDS's daily routine work does not get severely impacted. Consequently, it is proposed that multiple staggered sessions for training on each module will be held since all staff identified for training on those modules cannot be released at the same time. There will thus be overlaps as many staff members will be enrolled in multiple training sessions. As far as possible, and subject to training facility location and instructor availability, parallel training sessions will be organized to reduce the training schedule as practical.

All training should be planned out well in advance with a master training schedule that identifies when each training activity will be conducted for designated team members.

An important consideration in the training schedule is the recurrence of training. Frequencies should be instituted for specific training especially that needed for compliance with formal policies, processes, and procedures.

The proposed locations for the Centres are:

- PDS Headquarters, Accra
- Projects Office, Ring Road, Accra
- Tema Training Center, Tema
- Eastern Regional Office, Koforidua
- Ashanti SBU, Kumasi
- Central Region, Cape Coast

- Volta Regional Office, Ho

- Western Regional Office, Takoradi

In respect of training for the selected Key (Super) Users, the initial training will be on manufacturer's online training servers and the follow-on training will be on the training servers implemented at PDS for PDS's own ERP environment. Internet access will be provided to connect to the training serves hosted by the manufacturer/PDS.

This arrangement provides for considerable cost savings since the training sites will be established in each major region of the PDS jurisdiction — and used throughout the implementation. This will benefit everyone by reducing travel, training costs, as well as boarding and lodging costs.

It is expected that the training programme shall be sequenced and delivered to correspond with the implementation milestones, allowing PDS personnel to start operating the ERP as soon as possible after a functional module has been implemented. It would therefore be imperative that once the schedule is in place and agreed, PDS management ensures that the scheduled training occurs as expected.

As noted above, the above are recommended for consideration and may require further discussion and verification with PDS in terms of eventually available resources, equipment and connectivity as well as the vendor requirements and abilities.

1.4   Track and Record

It is expected that the PDS and the Training Teams will track the success of each training session to ensure mid-term effectiveness evaluation and adjustments. The expected individual training records should include, at the least:

- Personal data

- Record of training attended

- Examination or Certification results (where applicable)

- Any individual certifications obtained upon request

The tracking and recording of training participation will be database-driven and would be expected to be developed and implemented as an online system that would be accessible by the ERP project team.

1.5   Specialised Training Program

One of the goals of the training program is to identify and train ERP key users from within the PDS staff for each module. These staff will take over the role of training new users after implementation of the ERP when new staff join or if there are interdepartmental transfers and postings. We will call this "Train the Trainers" program.

Finally, technical training will be given to ICT technical staff to develop a cadre of specialists that can work on the following layers of the ERP System:

- Basis Support / Systems Administration o Installation and basic technical configuration of system o Database Management, e.g. maintenance / update management o Application maintenance / update management o Security management (access control) o Backup and restore management

- Customization Support o Minor customization and/or parameterisation of modules, application programming and report development

- General technical support to end-users, e.g. installation and configuration of client software, access management, e.g. reset my password

Ultimately, it is expected that the selected ERP Vendor prepares the requisite Training Manuals targeting different types and levels of training on the ERP System. The selected Vendor will provide all necessary end user functional and technical training for the ERP Technology products and application modules.

1.6   Key (Super) User Training

There will be overview presentations and workshops so that project team members can gain better insights and orientation to the application and the consequences it entails for their respective roles in the organization. These overviews and workshops will equip the team with the project policy, methodology, solution overview, functionality and other essential skills. These shall cover the overall functionality features offered by the ERP application.

1.7   End-User Training

End-user training is expected to be conducted by the selected ERP Vendor or a selected training partner of the same. The materials such as live examples and live scenarios will be prepared and agreed upon in advance. This training is role-based training and should be provided for the individuals in relation to the work performed by them utilising the ERP systems.

1.8   Training of ICT Support

ICT support will be for the individuals who will maintain the system and make sure that it is running in optimum condition. The selected ERP Vendor will provide System Administration, Application and Module Maintenance as well as Administration training to the PDS IT team as well as designated application systems administrators in the various directorates.

1.9   Training Material

Each participant should be given a role-based training kit, which is the main resource that will be used for training purposes. Training may comprise of Role Based User Manuals, Help Videos etc. It is expected that training would be carried out based on the ERP's vendor supplied training aids and instructor guides.

To facilitate the above, we will require ERP Vendors to provide all documentation according to best practices methodology in relation to the system implementation, configuration, system integration, system requirements, maintenance, programming, and training of the Financial, Procurement, Inventory, Payroll and Project Management, Project Costing modules of ERP. Documentation shall be included in the acceptance procedure and should be received by PDS as part of the system implementation.

The selected Vendor is requested to design and develop job role-based end user training materials to prepare users for the new system.

Once the training topics, the number of trainees and training methods have been identified and approved, the selected Vendor is required to provide the overall program content and structure which should be formalized and presented under two critical components:

1) Syllabus: The training program syllabus for the identified levels shall outline the entire framework of the formal training program and any associated qualification (eligibility conditions). It must list the training topics, who will receive the training, the method to be used for the training, and when each trainee shall be trained.

2) Lesson Plans: This will provide the scope of each training activity and also identify:

   ▪ The instructor

   ▪ The specific training activity content

   ▪ The goal of the training

   ▪ The successful completion of the training requirements

It should be noted that the ERP manufacturer's certified training should be provided so that PDS staff can opt to write the exam and get certified in the modules in which they are trained.

2. Annex 1: Module Training and Staff Count

Note to Bidder: this table presents a holistic training approach and structure. Please adhere to the respective table(s) which have been adjusted in the IFB.

Directorate	Training Sessions per Directorate (attendance / 25 classsize)	Finance & Accounting	Management Accounting	Field Services / Workforce Management	Enterprise Asset Management (excl. Fixed Assets in Financial Accounting)	Procurement Management	Material Management	Projects Management System (Capital Projects)	Fleet Management	Human Administration	HR - Performance Management	BW & KPI Management	Document Management (overview)
MD's Office	4	37	37	0	0	0	0	0	0	0	0	0	37
Commercial Services	74	8	372	364	364	364	372	0	0	0	0	0	0
Human Resources	9	0	0	0	0	0	0	0	0	111	112	0	0
Finance	16	379	25	1	0	1	1	0	0	0	0	0	0
Internal Audit	2	17	0	0	0	17	17	0	0	0	0	0	0
Legal Services	1	8	8	0	0	0	0	0	0	0	0	0	8
Operations	153	0	546	546	546	546	546	546	0	0	0	0	546
Engineering	8	0	50	0	0	50	0	50	0	0	0	0	50
NW Projects	5	0	65	0	0	0	0	0	65	0	0	0	0
Premises & Estates	6	0	46	0	0	46	0	46	0	0	0	0	0
Material & Transport	11	0	0	0	0	64	108	0	108	0	0	0	0
Procurement	1	0	9	9	0	9	9	0	0	0	0	0	0
Total No. of people to be trained per OrgUnit		449	1158	920	910	1097	1053	642	173	111	112	0	641
Total No. of people to be trained	7266												
Total No. Of Sessions	291												

ERP IT Environment Review Report

Development of ERP System for PDS – a MiDA Ghana Project

Additional Information in Support of the IFB v1.0 Submitted
on 29 July 2019

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Table 1: Document Change Control

Revision	Comment	Author	Date
v2	Final Report	Jürgen R. Weiss (JRW)	17/01/2019
v2	Additional Information in Support of the IFB v1.0	JRW	29/07/2019

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Abbreviations/Acronyms

Table 2: Abbreviations / Acronyms and Definitions

Abbreviations / Acronyms / Definition	Comment
ACL	Access Control List
AD	Active Directory
ADMS	Advanced Distribution Management System
AS	Anti-Spam
AV	Anti-Virus
AVR	Automatic Voltage Regulator
BC	Business Continuity
BCM	Business Continuity Management
BCP	Business Continuity Plan
BI	Business Intelligence
BIA	Business Impact Analysis
BoD	PDS Board of Directors
BSC	Balance Score Card
BPM	Business Process Management
BPMN	Business Process Model Notation
BU	Business Unit – Means any organizational component of PDS
BYOD	Bring your own device
CCTV	Closed-Circuit Television

CIFS	Common Internet File System
CMS	Content Management System
CMDB	Configuration Management Database
COBIT	Control Objectives for Information and Related Technologies
CPU	Central Processing Unit
CSC	Customer Service Centre
D2D	Disk-to-Disk
D2D2T	Disk-to-Disk-to-Tape
DB	Databases
DC	Data Centre
DCCN	Data Centre & Communication Network
DCIM	Data Centre Infrastructure Management
DDOS	Distributed Denial Of Service
DFS	Distributed File System
DHCP	Dynamic Host Configuration Protocol
DMS	Document Management System
DNS	Domain Name System
DO	District Office
DOS	Denial Of Service
DR	Disaster Recovery
DRM	Disaster Recovery Management
ECG	Electricity Company of Ghana
EA	Enterprise Architecture
ER	Environment Review
ERP	Enterprise Resource Planning

Abbreviations / Acronyms / Definition	Comment
ESB	Enterprise Service Bus
FR	Functional Requirements
FSRM	File Server Resource Manager
FW	Firewall
GFS	Grandfather-Father-Son
GIS	Geographical Information System
GL	General Ledger
Go-Live	Refers to a period in the development process of a project when the goals of this project are accomplished, desired outcome is produced, and deliverables are accepted, so the project is ready for realization and maintenance. It is an ending phase that embraces the timeframe between project completion and handover.[1]
GPO	Group Policy Object
GPS	Global Positioning System
HO or HQ	Head Office (Head Quarter)
HTML	Hypertext Markup Language
HTTP / HTTPS	Hypertext Transfer Protocol / HTTP Secure

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[1] http://www.taskmanagementguide.com/glossary/what-is-project-go-live.php

HVAC	Heating, Ventilation and Climate Control
IaaS	Infrastructure-as-a-Service
ICT	Information and Communication Technology
IDS	Intrusion Detection System
IFB	Invitation for Bids
IMAP	Internet Message Access Protocol
InCMS	Indra Customer Management System
IP	Internet Protocol
IPAM	Internet Protocol Address Management
IPS	Intrusion Prevention System
ISACA	Information Systems Audit and Control Association
ISO	International Organization for Standardization
ISP	Internet Service Provider
IT	Information Technology
IT or ICT BU	PDS IT Directorate (Information Technology Business Unit)
ITIL	Information Technology Infrastructure Library
ITSM	IT Service Management
KPI	Key Performance Indicator
KVM	Keyboard Video Mouse
LAN	Local Area Network
LB	Load Balancer
MAN	Metropolitan Area Network
MiDA	Millennium Development Authority
MMS	Meter Management System
MS	Microsoft
NAC	Network Access Control
NIC	Network Interface Card
NLA	Network Level Authentication
NOC	Network Operations Centre
NSP	Network Service Provider
OMS	Outage Management System

Abbreviations / Acronyms / Definition	Comment
OOB	Out of band
OS	Operating System
PCI	Peripheral Component Interface
PDS	Power Distribution Services Ghana Ltd.
PDU	Power Distribution Unit
PM	Project Management
PMBOK	Project Management Body of Knowledge
PoS	Point if Sale
PO	PDS Project Office location (building) in Accra

PoE	Power over Ethernet
POP3	Post Office Protocol version 3
PRINCE2	Projects In Controlled Environments
PTP	Point-to-Point
PTMP	Point-to-Multi-Point
QA	Quality Assurance
QoS	Quality of Service
R&D	Research and Development
RAM	Random Access Memory
RDP	Remote Desktop Protocol
RFP	Request for Proposal
RIB	Reverse Incremental Backup
RO	Regional Office
RPO	Recovery Point Objective
RTO	Recovery Time Objective
SaaS	Software-as-a-Service
Samba	Samba is a suite of tools handling the SMB protocol (also known as "CIFS") on Linux
SBU	Strategic Business Unit
SCADA	Supervisory Control and Data Acquisition
SCRUM	SCRUM is an iterative and incremental framework for managing product development
SHE	Safety, Health and Environment
SLA	Service Level Agreement
SMB	Server Message Block
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SOC	Security Operations Centre
SOP	Standard Operating Procedure
TCP	Transmission Control Protocol
TOGAF	The Open Group Architecture Framework
ToR	Terms of Reference
UAT	User Acceptance Testing
UPS	Uninterruptable Power Supply
URL	Uniform Resource Locator
UTM	Unified Thread Management
VC	Video Conferencing
vCPU	Virtual CPU
VM	Virtual Machine

Abbreviations / Acronyms / Definition	Comment
VoIP	Voice over IP
VPN	Virtual Private Network
VSS	Virtualisation, Servers & Storage

WAF	Web Application Firewall
WAN	Wide Area Network
WLAN	Wireless LAN
WP	Workstation & Peripheral
WWAN	Wireless WAN

1.   Introduction

Note to Bidder: *this document is additional information only and presents the holistic approach to the ERP project and incorporates Core and Optional Requirements. Please adhere to the definitions in the IFB.*

1.1   Document Structure

This document is structured into 11 sections as outlined below and follows a logical separation of the different aspects of PDS's ICT environment.

This first section provides an introduction and overview of the ERP IT environment assessment exercise, the approach followed and explains the structure of this report.

Section 2 outlines the high-level business and organisational structure of PDS with focus on the ICT business unit.

Section 3 provides information regarding PDS's ICT Operational Architecture, including ICT strategy, governance, policies and procedures, support services, IT management systems, project management, training aspects, operational and disaster recovery, as well as system monitoring, auditing and logging solutions.

Section 4 provides information regarding Information Systems, structured into UNIX/Linux Applications, Windows Applications, the Messaging infrastructure, Voice-over-IP systems, Database Management Systems, Document Management Systems, Intranets, Web Sites, enterprise-wide security systems and software licensing.

Section 5 covers Enterprise Services, including Active Directory, Time Synchronisation, Security Solutions, Thin-Client solutions, Load Balancing and Clustering technologies.

Section 6 describes the physical facilities such as data centres and server rooms, as well as building elements, environmental monitoring aspects, surveillance and physical security.

Section 7 describes the network infrastructure, separated into sections for Wide and Local Area Networks, Wireless Networks, Remote Access, Internet Access, TCP/IP setup, and Virtual LANs.

Section 8 covers PDS's server environment and provides details regarding Virtualisation, Windows- and UNIX/Linux-based servers and services, as well as the storage infrastructure.

Section 9 provides information on workstations and peripheral components. It covers the various devices' hardware, operating systems, desktop/application software and tools, as well as user data management and storage.

2.   Business and Organisation

This section outlines the high-level business and organisational structure of PDS with focus on the ICT business unit.

2.1   Business Overview

There are seven public institutions involved in the power sector. These are (1) the Ministry of Power (MOP), (2) Energy Commission (EC), (3) Public Utility Regulatory Commission (PURC), (4) Volta River Authority (VRA), (5) Ghana Grid Company (GRIDCo), (6) Electricity Company of Ghana Limited (PDS) and (7) the Northern Electricity Department Company (NEDCo), a subsidiary of the VRA. The Energy Foundation is a private-public sector partnership to promote energy efficiency and conservation countrywide. Independent Power Producers (IPPs) are further private sector players in the power generation sector.

The Electricity Company of Ghana is a limited liability company wholly owned by the Government of Ghana. The Electricity Company of Ghana Limited was incorporated under the Companies Code, 1963 (Act 179) in February 1997. It began as the Electricity Department on 1st April 1947 responsible for distribution power in the entire country and later became the Electricity Division in 1962. It was subsequently converted into the Electricity Corporation of Ghana by (NLCD 125) in 1967.

In 1987, the Northern Electricity Department (NED) was established under the Volta River Authority (VRA), to take over from PDS the responsibility of electric power distribution in the northern part of Ghana.

Since then PDS has been responsible for distribution of electricity in six political / administrative regions in southern Ghana namely the Greater Accra, Western, Ashanti, Central, Volta and Eastern regions.

The Government of Ghana, with support of MiDA, has awarded a concession arrangement under the Ghana Power Compact II programme to Philippines energy firm, Meralco Consortium, to manage the PDS from 2019 onwards. The takeover of PDS by Meralco is supposed to address the technical and commercial losses, which PDS had not been able to reduce for many years. The ultimate goal is to make PDS an efficient organisation.

2.2   Organisation Overview

PDS's organisation is structured as per the following diagram.

Figure 1: Organogram – Main Business Units
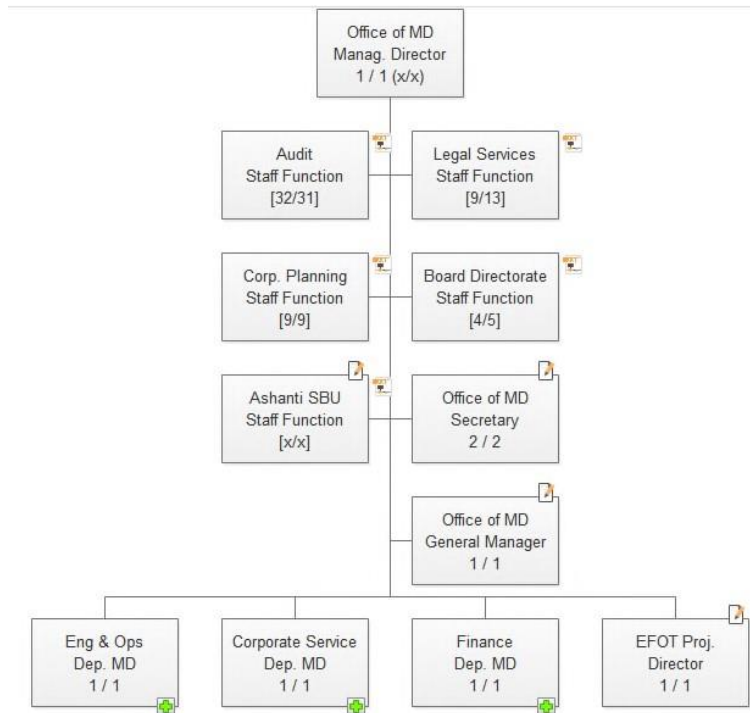
2.3   Business Locations

The Head Office of PDS and other central offices, such as the Project Office, are located in Accra, the capital city of Ghana. The geographical area served by PDS is split into six regions as depicted in Figure 2. Greater Accra is further divided into Accra East, Accra West and Tema each having their own regional and district offices. For a complete list of PDS's business locations where PDS's employees use IT resources refer to Table 3.

In addition to PDS's own business location there are more than 400 third party retail vendors selling pre-paid electricity to customers which require access to some of PDS's IT resources.

Figure 2: Map of Ghana and Regions of PDS

Table 3: Business Locations[2]

Region	Ref.	Location Name	Location Details	GPS Coordinates (Lat/Long)	#Users
Accra	1	Electro Volta House (HO)	Head Office (HO)	5°32'58.44"N / 0°11'40.92"W	N/A
	2	Project Office		5°34'1.10"N / 0°13'10.00"W	71
	3	Heritage Towers		5°33'24.88"N / 0°12'5.19"W	N/A
	4	Training School		5°39'26.86"N / 0° 0'58.37"W	79
	5	Tema Depot		5°38'52.23"N / 0° 0'18.56"E	65
	6	Tema Bonded		5°40'20.53"N / 0° 1'16.64"W	N/A
	7	Substation G		5°32'50.21"N / 0°12'21.10"W	N/A
Accra East	8	Makola	Regional Office	N/A	N/A
7 x DO	9	S/E Makola	District Office	5.54795 / -0.20395	89
	10	N/E Legon	District Office	5.655596 / -0.180606	91
	11	Mampong	District Office	5°55'4.19"N / 0° 8'8.56"W	N/A
	12	Roman Ridge	District Office	5°35'54.23"N / 0°11'32.03"W	71
	13	Teshie	District Office	5.6033 / -0.12084	53
	14	Kwabenya	District Office	5.66742 / -0.23473	70
	15	Dodowa	District Office	N/A	70

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[2] For more location information refer to http://PDSgh.com/index.php/customer-care/billing/centers.html,
http://PDSgh.com/index.php/contact-us.html and Tigo SLA (Schedule 2) for 35 Customer Vending Stations.

Accra West	16	Avenor	Regional Office	5.57926 / -0.22062	N/A
7 x DO	17	Kaneshie DO	District Office	5.57926 / -0.22062	72
	18	S/W Korle Bu	District Office	5.5349 / -0.2333	75
	19	N/W Achimota	District Office	5.63921 / -0.24229	68
	20	Nsawam	District Office	5.807 / -0.344333	84
	21	Danosman	District Office	5.54075 / -0.265139	72
	22	Kaneshie	District Office , Same yard as RO	5.57926 / -0.22062	72
	23	Abelekuma	District Office	5°37'19.14"N / 0°18'3.02"W	N/A

Region	Ref.	Location Name	Location Details	GPS Coordinates (Lat/Long)	#Users
Tema	24	Tema	Regional Office	5.6394 / -0.00803	N/A
7 x DO	25	South	District Office	5°38'28.42"N / 0° 0'15.91"W	62
	26	North	District Office	5°40'17.22"N / 0° 1'16.50"W	62
	27	Prampram	District Office	5.71048 / 0.10977	40
	28	Nungua	District Office	5°38'30.32"N / 0° 3'31.35"W	71
	29	Afienya	District Office	5.80127 / 0.00595	70
	30	Ada	District Office	5.80495 / 0.61544	44
	31	Somanya / Krobo	District Office	6° 6'3.60"N / 0° 1'28.31"W	56
Ashanti West	32	Adum Office	District Office	N/A	N/A
15 x DO	33	Abuakwa	District Office	6.67693 / -1.63871	71
	34	Suame	District Office	6.690191 / -1.623371	55
	35	Danyame	District Office	6.676693 / -1.63875	92
	36	Workshop	Workshop	6°41'21.93"N / 1°37'34.82"W	N/A
	37	Obuasi	District Office	6°12'20.67"N / 1°40'14.06"W	52
	38	Dunkwa	District Office	5°57'40.54"N / 1°46'29.96"W	29
	39	New Edubiase	District Office	6° 3'38.81"N / 1°23'34.15"W	20
	40	Bekwai	District Office	6.455749 / -1.581943	42
	41	Offinso	District Office	N/A	29
Ashanti East	42	Kumasi / Manhyia	Reginal Office (HO SBU)	6.708195 / -1.60656	N/A
6 x DO	43	Konongo	District Office	6.623749 / -1.218264	34

Region	Ref.	Location Name	Location Details	GPS Coordinates (Lat/Long)	#Users
	44	Effiduase	District Office	6.844609 / -1.390689	32
	45	Mampong	District Office	7.009637 / -1.396414	40
	46	Kwabre	District Office	6.754626 / -1.599366	56
	47	Ayigya	District Office	6.55658 / -1.5812	63
	48	Asokwa	District Office	6.675524 / -1.603218	65
Western	49	Takoradi	Regional Office	4.88911 / -1.74984	N/A
12 x DO	50	Sekondi	District Office	4.934691 / -1.710278	85
	51	Bibiani	District Office	6°27'22.28"N / 2°19'12.25"W	32
	52	Sefwi Wiaso	District Office	6°12'23.72"N / 2°29'23.93"W	57
	53	Juabeso	District Office	6°20'31.34"N / 2°49'49.37"W	27
	54	Enchi	District Office	5°49'42.56"N / 2°49'13.73"W	22
	55	Asankragwa	District Office	5°48'59.15"N / 2°26'1.36"W	N/A
	56	Tarkwa	District Office	5°17'59.53"N / 1°59'56.47"W	68
	57	Axim	District Office	4°56'38.58"N / 2°20'36.82"W	36
	58	Half Assini	District Office	5° 2'53.48"N / 2°52'23.59"W	6
	59	Bogoso	District Office	5° 32'55.8"N / 1°59'52.6"W	N/A
	60	Agona Nkantwa	District Office	4°53'27.92"N / 1°57'36.05"W	N/A
Central	61	Cape Coast	Regional Office	5°34'43.64"N / 1° 0'15.16"W	N/A
10 x DO	62	Breman Asikuma	District Office	5.11492 / -1.24314	24
	63	Saltpond	District Office	5.20644 / -1.05814	51
	64	Ajumako	District Office	5.42928 / -0.9603	24
	65	Swedru	District Office	5°31'31.40"N / 0°41'55.11"W	58
	66	Winneba	District Office	5.377947 -0.642004	53
	67	Kasoa North	District Office	5°32'0.89"N / 0°25'31.73"W	N/A
	68	Kasoa South	District Office	5°32'5.97"N / 0°24'44.79"W	N/A
	69	Twifo Praso	District Office	5°36'33.59"N / 1°32'48.41"W	27
	70	Assin Fosu	District Office	5°42'0.04"N / 1°16'39.11"W	35
Eastern	71	Koforidua	Regional Office	6.09678 / -0.25856	N/A
Region	**Ref.**	**Location Name**	**Location Details**	**GPS Coordinates (Lat/Long)**	**#Users**

14 x DO	72	Nkawkaw	District Office	6.556671 / -0.7796969	40
	73	Suhum	District Office	6° 2'28.36"N / 0°26'34.37"W	23
	74	Kiwi	District Office	6° 9'29.608"N / 0°33'32.819"W	N/A
	75	Donkorkrom	District Office	6° 2'28.36"N / 0°26'34.37"W	23
	76	Akwatia	District Office	6° 2'28.36"N / 0°26'34.37"W	25
	77	Asamankese	District Office	5°51'52.63"N / 0°40'7.39"W	28
	78	Akim Oda	District Office	5°55'50.30"N / 0°58'46.60"W	53
	79	New Abriem	District Office	6°20'34.19"N / 0°59'52.19"W	20
	80	Akim Tafo	District Office	6°34'32.00"N / 0°45'32.00"W	44
	81	Assesewa	District Office	6°13'22.22"N / 0°21'52.45"W	20
	82	Mpraeso	District Office	6°22'56.64"N / 0° 8'39.91"W	25
	83	Begoro	District Office	6°23'16.19"N / 0°22'35.18"W	17
Volta	84	Ho	Regional Office	6.611687 / 0.4626487	N/A
11 x DO	85	Kpando	District Office	6.99739 / 0.3001039	33
	86	Hohoe	District Office	7.14378 / 0.47694	36
	87	Jasikan	District Office	7.4098 / 0.45849	30
	88	Akatsi	District Office	6° 7'0.84"N / 0°46'54.66"E	33
	89	Keta	District Office	5°53'28.57"N / 0°59'5.82"E	31
	90	Denu	District Office	6° 5'56.77"N / 1° 8'57.31"E	48
	91	Kpeve	District Office	6°40'47.99"N / 0°19'36.73"E	47
	92	Sogakope	District Office	6° 0'3.38"N / 0°36'2.84"E	30
	93	Dambai	District Office	8° 3'58.50"N / 0°10'44.65"E	18
	94	Nkantwa	District Office	8°15'39.95"N / 0°31'3.83"E	16
TOTAL					**N/A**

A geographical map depicting all business locations was not made available by the ICT BU.

2.3.1   Site Locations

Property and buildings maps for each business location are managed by the Premises & Estate Directorate.

Table 4: Site Location Details

Ref.	Location Name	Building / Office	Business Unit(s)	#Users
1	N/A	N/A	N/A	N/A

2.4   ICT Business Unit

The ICT Business Unit is a Directorate located in the Project Office in Accra and falls, from an organisational perspective, under the Finance business unit which is headed by a Deputy Managing Director (DMD), who reports directly to PDS's Managing Director.

Figure 3: Organogram – ICT Business Unit
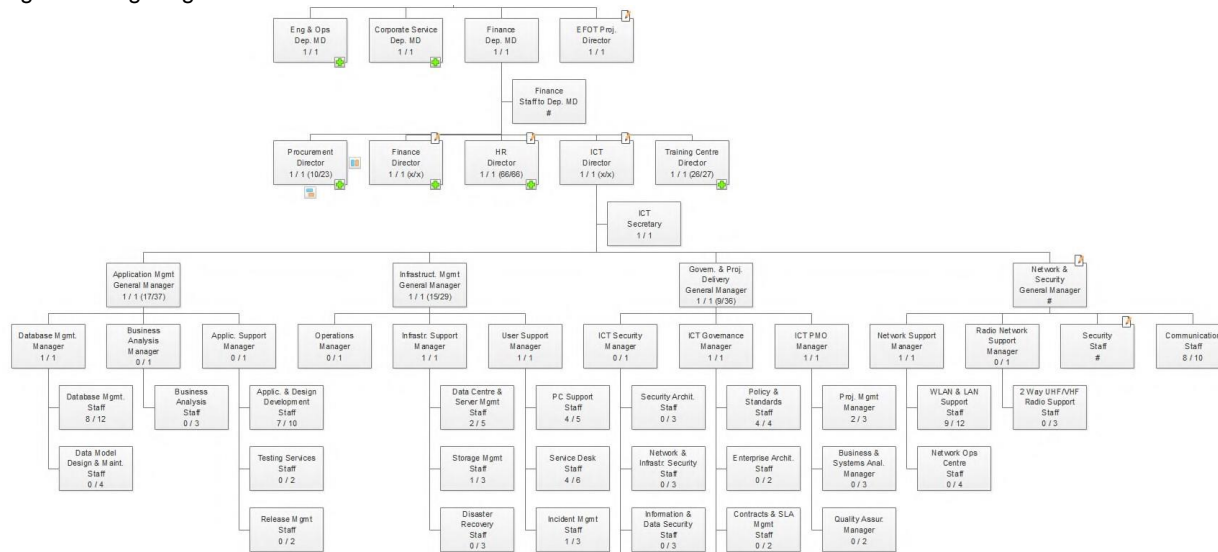
The ICT BU in Accra is subdivided into four divisions each with a General Manager as head[3]reporting to the ICT Director, Mr. John Kwaw Amihere Mensah.

- **Application Management** (Mr. Anthony X. Sossah) – Responsible for planning, designing, developing and managing the processes/systems required for the provision of user applications and systems necessary for the facilitation of PDS's business operations. Scope of work includes supervising and maintaining the company's repository of software applications in line with approved ICT governance and international best practices.

- **Infrastructure Management** (Mr. Aheng Owusu-Afriyie) – Responsible for managing PDS's ICT infrastructure and supervise/coordinate the installation, configuration and operational maintenance of systems hardware and related peripherals. Scope of work includes maintaining and supporting network/server infrastructure, storage, backup/recovery and data communications/ telecommunications systems to facilitate the operations of the company.

- **Governance and Project Delivery** (Mr. Edward Osei-Tawiah) – Responsible for the development of PDS's ICT governance, control systems, policies, procedures, standards and risk management processes to support ICT applications and software, projects, purchases, services and usage throughout PDS. Scope of work includes monitoring service providers and

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[3] The information provided in this section are based on the document "PDS - Job Descriptions Report - ICT Directorate" dated July 2013 and on organisational structure information provided by PDS ERP Project Management.

Users to ensure adherence with approved company policy and procedures and international best practice.

▪ **Network and Security Management** (Acting: Ms. Stella Gomashie) – Responsible for managing, coordinating, maintaining and monitoring diverse range of services to ensure PDS has a resilient and secured Wide Area Networks (WAN), Local Area Networks (LAN) and communications capability to support the provision of IT and communications in operational locations.

Up-to-date job descriptions of the respective positions under the ICT Directorate in Accra were not available at the time of compiling this report.

Furthermore, each region has its own ICT component and staff which form part of the regional organisational structure and therefore report to regional management with an indirect reporting line to the ICT BU in Accra.

The staff complement of the regions of PDS are outlined below. All regional ICT staff is located in the regional offices; no personnel is permanently placed in any district office. Further information about the responsibilities of the regional ICT components, organograms or job descriptions of the respective positions were not made available.

Table 5: Regional ICT Organisation

Region	Office	No. of ICT Staff
Greater Accra	Accra East	N/A
	Accra West	3
	Tema	N/A
Ashanti SBU	Kumasi	9
Central	Cape Coast	4
Eastern	Koforidua	4
Volta	Ho	3
Western	Takoradi	6
TOTAL		**N/A**

The ICT BU provides after hour services (weekends, public holidays, etc) but no standby roster was made available.

2.5 Business Communication

PDS operates telecommunication links for business purposes as listed below (excludes any Internet / WAN links).

The vending stations typically access PDS's IT resources via a dedicated Access Point Name (APN) which enables individual cellular devices or machines to get authenticated (via a cell phone or MSISDN number) when they gain access to PDS's network or application.

Table 6: Business Communication

PDS BU	External Entity	Provider	Link Type / Capacity	Purpose / Comment	Importance
Finance	Banks	N/A	N/A	Payment collections, Pre-paid	High
Commercial Services	MTN	N/A	N/A	Mobile payments	High
Commercial Services	Vending Stations	Various	APN	Smart Meters & PoS devices	High

2.6   ICT 3rd Party Relationships

PDS's ICT BU entertains the following ongoing relationships with external parties (excludes nonregular relationships, such as goods providers).

Table 7: 3rd Party Relationships

Vendor	Products / Services	Contract	Details
EDMI Singapore	MultiDrive AMR System	Signed	Provision of support and maintenance services (software only)
Tigo (Millicom Ghana)	WAN Connectivity	Signed	2 Mbps, full-duplex last mile connectivity for 35 Customer Vending Stations 100 Mbps, full duplex aggregation backhaul between Tigo Office and the PDS's Project Office
Glo-Mobile Ghana	Internet Bandwidth	Draft	STM-1 (155Mbps) Internet Bandwidth Capacity services. PDS may resell capacity
Gridco	WAN Connectivity	N/A	Leased line circuits
MTN Ghana	WAN Connectivity & Internet Bandwidth	Draft	Leased line circuits, Internet Bandwidth, APN and Voice
Vodafone Ghana	WAN Connectivity & Internet Bandwidth	Draft	Leased line circuits, Internet Bandwidth, APN and Voice
Various	Pre-Paid Systems	Unknown	Support agreements with pre-paid system suppliers, but no details known
Oracle	E-Business Suite	Unknown	HCM Payroll, BSC/SSM, EAM

Note: PDS contracts are archived by the Legal Department

2.7   Business and Organisation – Planned Changes

No changes, except filling of vacant positions, are planned for the ICT Business Unit organisation.

Table 8: Business / Organisation – Planned Changes

Project	Timeline	Budget [US$]	Completed [%]
N/A			

3.   Operational Architecture

This section encompasses information regarding PDS's Operational Architecture, including strategy, governance, policies, processes and procedures, support services, project management, training aspects, operational and disaster recovery, system monitoring, auditing and logging, as well as IT management systems.

3.1   IT Strategy

The ICT BU presented the following documents as foundation of PDS's ICT Strategy:

1)   PDS ICT Strategy Final Report v2.0, dated 20 Nov. 2012;

2)   PDS ICT Operational Plan Final Report v2, dated 06 Jun. 2014;

3)   PDS ICT Gap Analysis Final Report v11-2, dated 15 Dec. 2017; and

4)   PDS ICT Strategy Final BSC 2018 v6.2-1 (Balance Score Card), dated 18 Oct. 2018.

An electronic copy of the most recent corporate strategy document (business plan) of PDS was not available on time to review alignment of the ICT Strategy with the business strategy of PDS. Report 1) above is the latest, approved ICT Strategy document. PDS's Board of Directors has approved above documents. However, it is unclear in how far they are supported and controlled by Executive and the BoD.

3.2   IT Governance

Currently there are no formally endorsed plans for an IT governance structure in place under which PDS's IT strategy could be implemented. However, the ICT BU intends to adopt the Cobit 5 framework.

For IT Service Management (ITSM) PDS has adopted the ITIL v3 framework, but has not adapted and implemented the framework.

PDS plans to adopt the international standards "ISO 27001:2013" and PCI DSS to manage its IT Security risks. The Balance Score Card of the ICT BU lists *inter alia* as initiative to "acquire ISO and PCI DSS security certifications for PDS's digital payments infrastructure". Completed compliance checklists, self-assessments, or associated evidence and controls in regard to the implementation of ISO 27001, or PCI DSS, could not be provided by PDS.

PDS intends to align with ISO 22301:2012, an international standard for Business Continuity Management.

PDS's ICT Strategy recommends adopting TOGAF 9 as Enterprise Architecture framework. However, the ICT BU has neither adapted, nor implemented the framework.

The latest Balance Score Card (BSC) of the ICT BU requires that PMBOK is adopted and implemented as Project Management framework. However, the ICT BU has neither adapted, nor implemented the framework.

3.3   IT Risk, Compliance and Conformance

Documented *corporate* Risk, Compliance or Conformance policies, registers and other related documentation have been made available as follows:

▪ Risks:

  o Risk Management Strategy and Policy; o Risk Management

    Strategy June 2016 – May 2018; o Risk Management Policy,

    dated Jul. 2017; o Risk Management Teams; o Incident

    Reporting and Management Procedures; o Risk Management

    SOPs; o Board Risk & Assurance Framework (Draft), dated

    Nov. 2015; o Risk Register-2.

▪ Compliance: o None;

▪ Conformance:

  o None.

PDS has neither adopted nor implemented a formal Risk Management framework. However, it intends to align with the ISACA framework.

The registers in the "Board Risk & Assurance Framework (Draft)" and "Risk Register-2" documents contain a mixture of risks, objectives and goals.

The IT Risk register forms part of the "Risk Register-2", contains over 400 IT related risks, but the documentation is incomplete and not all risks are addressed, e.g. processes and people risks.

There are no documented IT Compliance or Conformance registers.

3.4   IT Policies, Processes and Procedures

3.4.1   Policies

The policies listed in this section have been summarised as per the provided objective statements contained in the policies.

ICT Policies approved by PDS Executive and Board:

- **Policies Introduction**, dated Jun. 2016, introduces the concept of PDS's ICT policies, requires compliance from users and third-parties, states the enforcement if the policies and contains a compliance form to be signed by all employees.

- **Acceptable Use Policy**, dated Aug. 2016, has the purpose to specify the appropriate use of PDS's ICT resources by all users. The policy has the ultimate aim of ensuring that users of information assets use them for work related purposes and comply with all ICT polices in order to maximise the use of ICT resources and protect the company against damaging legal issues. It, however, provides only minimal, basic rules for end-users.

- **End-User Password Policy**, dated Aug. 2016, establishes a standard for the creation of robust passwords, the protection of these passwords, and to facilitate periodic changing of passwords such that, they are strong, secure, and protected.

- **End-User Backup Policy**, dated Aug. 2016, has the goal to outline the stipulations and procedures that govern how and when data residing on ICT assets will be backed up and stored for the purpose of providing restoration capability. The policy refers to the backing up of data that resides on corporate computers, Personal Digital Assistance (PDA) and other approved devices. The policy does not cover end-user's personal information that is saved on a network or shared drive.

- **Antivirus Policy**, dated Aug. 2016, has the objective to establish principles which must be adhered to in order to prevent malicious codes from entering the corporate ICT infrastructure. It provides guidelines on identifying and reporting suspected virus attacks, and defines appropriate actions to eliminate and recover from virus related incidents.

- **Asset Disposal Policy**, dated Aug. 2016, has the purpose to establish and define standards and procedures for the disposal of non-leased ICT assets or equipment in a legal and cost effective manner. PDS's unserviceable ICT assets and resources must be disposed of through the appropriate change management procedure. Therefore, all disposal procedures for retired ICT assets must adhere to company-approved methods.

- **Service Desk Policy**, dated Aug. 2016, is to provide a framework for reporting and resolving all ICT support issues within PDS. The aim is to resolve 99% of all requests for assistance on supported applications within one (1) business day.

- **Change Management Policy**, dated Aug. 2016, has the purpose to ensure that change management and control strategies implementation mitigate associated risks such as: Information being corrupted and/or destroyed, computer performance being disrupted and/or degraded, productivity losses being incurred and exposure to reputational risk.

- **Physical and Environmental Policy**, dated Aug. 2016, has the purpose to establish to define a set of requirements that defines the minimum level of physical and environmental security for all PDS facilities to protect information resources.

- **Security Policy**, dated March 2018, has the objective provide management direction and support for information security in accordance with business requirements and relevant laws and regulations. The main aims of the information security policy are to preserve confidentiality, integrity, availability, and to support accountability and non-repudiation.

ICT Policies in draft status:

- **Systems Administration Policy**, provides guidelines for the administration of information technology systems and resources within the PDS.

- **Server Infrastructure Replacement Policy**, has the purpose to establish refresh cycles for PDS's servers and associated technologies at various levels of criticality to ensure that service delivery is not unduly interrupted to cost the company financially and reputation wise.

- **Server Backup and Recovery Policy**, dated May 2018, has the goal to outline the provisions and procedures that govern how and when data residing on ICT assets will be backed up and stored for the purpose of providing restoration capability. It also outlines how systems should be configured to ensure high availability to assist the organisation readiness position in protecting its data, staff and users of services.

- **Business Continuity Policy**, dated Aug. 2017, defines a broad framework for the implementation of PDS's Business Continuity Management System to minimise the impact of Business Continuity incidents / disruption. It applies to all services including hosted services, activities and staff within PDS.

Little evidence could be established that proves the successful implementation and enforcement of above policies. Furthermore, controls that monitor policies are not in place.

3.4.2 Processes and Procedures

Except for some aspects in regard to its Business Continuity / Disaster Recovery efforts, processes or procedures relevant to PDS's ICT environment are neither documented nor endorsed.

3.4.3 Naming Standards and Conventions

PDS has no formal documented and approved naming standards for ICT assets (e.g. network devices, servers, storage devices, workstations and peripherals), user accounts, security groups, GPOs or other AD objects, physical / virtual DNS Hostnames (e.g. servers, switches, routers, etc.), email addresses, distribution lists or other messaging system objects, or any other relevant ICT objects in place. However, in some areas certain standards are applied informally (refer to Table 9 below).

Table 9: Naming Standard of Network & Security Division

Centre Name	Environment	Center type	Physical/Virtual	O.S.	Role	Number
PRO = Accra project office **ELV**=Headoffice **ACW**= Accra West **ACE**=Accra East	**M**=Multi	**P**=Primary **R**=Recovery	**P**=Physical **V**=Virtual	**L**=Linux **W**=Windows X=XenServer O=OVM P=Propietary	**CT**=Citrix	**01-99**

TMA=Tema Region **VOL**=Volta Region **EST**=Eastern Region **CEN**=Central Region **WST**=Westen Region **ASW**=Ashanti West **ASE**=Ashanti East Acc=Accra AK = Asokwa GH = Guest House PG = Pedu Goil SP = Saltpond AJ = Ajumako WN = Winneba SD = Swedru EF = Effiduase OC = Otec	**P**=Production **Q**=Q&A **D**=Development	VS -Vending Station S=Substation			**AP**=Application **DB**=Database **SW**=Ethernet Switch **SA**=Storage Array **HY**=Hypervisor **LB**=Load Balancer **DC**=Domain Controller **FS**=File Server **FT**=FTP Server **UP**=UPS **RT**=Router **AV**=AVR **RK**=RACK **CA**-Certificate Authority MX-Mail **NM**=Network Monitoring

PDS does not have a formal documented, approved labelling standard for ICT assets, cabling and accessories (e.g. patch panels). However, certain conventions are applied.

3.5   IT Documentation

The ICT BU compiled a template named "PDS ICT Systems Administration Manual Template", last updated 06 Sep. 2017, which serves as a guideline for System Administrators on how to document systems. However, no documentation that applied the template for a specific system has been supplied by the ICT BU.

The template is a general-purpose template and, in many aspects, very high-level leaving substantial room for interpretation. No guidelines for documenting processes, procedures, technical diagrams, diagram narratives, standard configuration, and other essential technical documentation could be provided by the ICT BU.

3.6   IT Service Management

3.6.1   Processes

The ICT BU of PDS has decided to adopt the ITIL v3 framework as foundation for its IT Service Management.

The "Service Desk Policy" of PDS defines a few, basic guidelines for Incident Management and Service Request Fulfilment.

The "Change Management Policy" elaborates in length about change management, but mixes policy statements with process and other descriptions. According to the ICT BU, Problem Management is applied informally. The policy is also not implemented (CAB does not exist, and meetings never took place).

There are neither process diagrams for any of the ITSM processes, nor are there sufficient narratives for the processes. No evidence could be provided that the adopted ITSM processes are implemented and controlled as per defined policies and processes.

The ICT BU does not have a documented Service Catalogue. Furthermore, standard / recurrent tasks including the required type of HR resources, frequency and time needed to fulfil typical tasks of the ICT BU are not defined or documented. Standard Operating Procedures (SOPs) are not available.

3.6.2 Configuration Standards

PDS does not have defined and documented standards or procedures for installing and configuring IT hardware or software (configuration of hostnames, aliases, labelling, security hardening, allowed services, protocol/port restrictions/settings, etc.).

3.6.3 Service Desk System

PDS deployed and uses a Service Desk system from Combodo named iTop (https://www.combodo.com/itop-193). The system is installed on a Windows server using a MySQL Database. It is planned to replace iTop with an ITSM solution named SysAid (https://www.sysaid.com). The internal owner of the Service Desk system is the Support Manager positioned in the Infrastructure Division of the ICT BU.

The iTop system is, according to feedback from the IT BU of PDS, not used to its fullest extent. There are Service Desk reports regularly provided to Executive outlining performance of the ICT BU compared to service levels as agreed in the internal SLAs concluded (sample internal SLA is attached hereto) with the other main business units of PDS. The reports are provided on a quarterly basis at the respective review meetings. The ICT BU meets with the other directorates to explain deviations from the agreed SLAs.

The iTop system has Service Desk dashboards to show live performance of the ICT business unit, but it is not rolled out to the end-user community. The iTop system is accessible by endusers but not really used to log issues encountered. Preference is given by the end-users to contact the ICT BU by phone for any support.

Reports, as listed below, which provide evidence of Service Desk System utilisation, are not available:

- Type of tickets and originator;

- Overview of completed tickets;

- Overview of open tickets;

- Ticket Aging;

- Average Response and Resolution Time;

- Average Work Effort for Resolving Tickets;

- Percent of Tickets escalated, re-assigned, re-opened and resolved in target time;

- KPI Summary and Trends; and

- User ratings of ticket resolve quality.

3.7   Patch and Update Management

The ICT BU reported that a Patch Management Policy exists, and that Anti-Virus, OS and application patches are applied on a weekly basis. However, neither the policy document nor other prove was made available that provides evidence of successful patch management. Indeed, the information that was made available shows that firmware of the Mikrotik devices varies substantially, Anti-Virus agents are not installed on workstations, Anti-Virus updates are not applied successfully and that end-of-support products are still in operation, e.g. Microsoft Windows Server 2003 (support ended 14 July 2015).

3.8   Enterprise Architecture

PDS has adopted TOGAF 9 as Enterprise Architecture (EA) framework. However, no adaptation and implementation took place up until now and no policies, processes and procedures have been defined for EA.

3.9   Project Management

PDS has adopted PMBOK as Project Management (PM) framework. However, no adaptation and implementation took place up until now and no policies, processes and procedures have been defined for PM.

The ICT BU has not deployed or uses any centralised project management solution. Microsoft Project Professional is used for some projects in PDS. There is no project management system used across PDS.

3.10 Training

PDS indicated a formal ICT training programme for its end-users. However, no details of the training programme were provided.

This years' planned training programme for the ICT personnel has been added as Attachment **Error! Reference source not found.**.

3.11 Operational Recovery

3.11.1 Redundancy

Limited operational recovery (OR) is in place:

- All storage (servers, NAS) is protected by RAID modes.
- All devices in the Project Office and Legon Data Centres are protected by UPS. Most devices in the Server Rooms of the various Regional and District Offices are protected either by UPSs or inverters with batteries.
- The power supply in PDS's Data Centres and Server Rooms originate from a single, normal electricity grid.
- Most core switches, routers and servers have redundant power supplies.
- Access switches and some routers do not have redundant power supplies.
- Most servers do not have redundant Network Interface Cards (NICs).
- Some spare parts / devices, such as for the switches and routers, are kept on premise by PDS.
- The core, distribution and access layers have no device redundancy (single switches / routers).
- No connectivity redundancy exists between buildings and no redundancy between access and core/distribution switches (uplinks).

- ■

  Virtualisation environments (Hype-V and VMware) are not clustered providing, therefore, no protection of the VM environment (no shared storage).

- ■ Files stored on the NAS in the Project office DC are replicated to the NAS at Legon DC using Synology cluster technology.

- ■ Most applications are not setup or configured for automatic or manual failover.

3.11.2   Backup

Some guidelines for backups are documented in the End-User Backup Policy, dated Aug. 2016, and the Server Backup and Recovery Policy, dated May 2018 (refer to Section 3.4.1). However, PDS has no documented best-practise backup plan and procedures defined.

PDS uses a backup solution from Nakivo Backup & Replication (https://www.nakivo.com/). The solution only supports Disk-to-Disk (D2D) backups, and stores backup and metadata on a normal file   system   (no   database   back-end).   Furthermore,   SQL Backup   Master (https://www.sqlbackupmaster.com) from Key Metric Software is deployed to carry out MS SQL server backups to disk.

No information was provided about the implemented backup strategy PDS (e.g. GFS, RIB, etc.). Backups at the project office Data Centre and Legon are carried out firstly to local storage of a server (hard disk), thereafter to the Synology NAS in the Data Centre where the server is placed, and finally replicated to the Synology NAS of the other Data Centre in Accra (from PO DC to Legon DC, or from Legon DC to PO DC). Backups are carried out at frequencies that vary from hourly to weekly.

Backups of the servers hosting the pre-paid MMS are carried out to locally attached disks of another server of the MMS vendor. The ICT BU has neither insight nor control over the reliability of the MMS backups.

No information is available how systems and data are backed up at the Regional or District offices.

Backup jobs do not encrypt their data.

Backup status reports of the NAKIVO or other backup solutions providing evidence of successful execution could not be obtained.

Backups are carried out as follows for:

- ■ Physical Windows servers – N/A

- ■ Physical Linux/UNIX servers – N/A

- ■ Citrix host servers – N/A

- ▪
- ▪ VMware host servers – N/A

  Microsoft host servers – N/A

- ▪ Citrix XenServer VMs – N/A

- ▪ VMware ESXi VMs – N/A

- ▪ File system(s) – N/A ▪ MS Exchange – N/A

- ▪ MS SQL Server – N/A

- ▪ MS Oracle DBMS – N/A

- ▪ MySQL DBMS – N/A

- ▪ Applications – N/A

- ▪ Other – N/A

PDS does take any backups offsite from any of the PDS Data Centres and no backup vault exists. There is no procedure documented how to handle offsite media. It is unknown how long backup media is stored.

Although for some systems restore procedures are documented, it is unknown when and at what frequencies verifications of restores are carried out and how such verification exercises are recorded.

Backups are carried out as per the tables that follow.

Table 10: Daily Backup Tasks

Server / System	Solution	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
N/A								

For each task specify under the respective day: Full (F), Incremental (I), Differential (D), Other (O)

Table 11: Weekly Backup Tasks

Server / System	Solution	Week 1	Week 2	Week 3	Week 4
N/A					

For each task specify under the respective day: Full (F), Incremental (I), Differential (D), Other (O)

Table 12: Monthly Backup Tasks

Server / System	Solution	Jan.	Feb.	Mar.	Apr.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
N/A												

For each task specify under the respective day: Full (F), Incremental (I), Differential (D), Other (O)

▪

3.12   Disaster Recovery

The ICT BU made available the following Business Continuity (BC) and Disaster Recovery (DR) documentation:

  ICT Business Continuity Policy

- ▪ ICT Business Continuity Plan

- ▪ Critical Incident Management and Support Teams

- ▪ Business Continuity Procedure

- ▪ Systems Recovery Plan

- ▪ Systems Recovery Priorities

- ▪ Replication Testing Procedure

- ▪ Various documents covering business continuity, system recovery and testing for the applications AIMIR NURI, BOT, ECASH and InCMS.

The supplied documentation is not formally approved, some is in draft status and is overly complex, partially overlapping and in many instances too vague, especially when it comes to the backup and recovery procedures.

The objectives and goals of BC and DR are generically defined in above documents. A high-level risks assessment including a thread analysis has been carried out, but both are incomplete and not up-to-date. RPOs and RTOs are not defined for all information, related information systems and the underlying technology. The ICT BU stated in a workshop and in some of the above documents that its objective is to achieve 100% uptime for all PDS systems. Other documents define an uptime objective of 99.99% for systems like the InCMS.

The DR Strategy (approach, escalation, critical services, backup strategy, alternate office site, etc.) and the DR Organisation is defined in above documents, but requires updating. A DR Plan (preventative measures, backup plan, incident response, procedures, etc.) has been compiled covering some aspects of PDS's ICT environment, but is incomplete and not up-to-date.

The DR Framework Administration (Recovery Manager, distribution, maintenance of Risk Assessment and DR Framework, training, testing, etc.) has been defined to a limited extend in above documents.

The BC / DR documentation in regard to organisational contact register, key customer register, vendor contact register, SLA register and DR inventory is incomplete and not up-to-date. There are no forms defined to manage BC / DR processes, nor is any system documentation included in above documentation.

-

Some activities are undertaken by the ICT BU to drive PDS's BC and DR efforts forward, such as a stakeholder meeting with the Pre-Paid System vendors in 2018 and updates to above documentation thereafter.

3.12.1   DR Site

PDS's primary Data Centre is located close to the Kaneshie Market in Accra. A secondary Data Centre is located in the suburb Legon, Accra, on the premises of the PDS Legon District Office. Both Data Centres are about 13 km apart from each other. A third Data Centre (under construction) is located in Kumasi, at the Regional Office of the Ashanti SBU, with a distance of about 240 km between the Project Office DC and the Kumasi DC.

There are considerable differences in setup and configuration between the Project Office DC and the Legon DC, and some, but not all systems and data, are replicated between the two DCs.

PDS is considering using Kumasi as DR site once construction has been completed. However, the distance between Project Office DC and Kumasi, in conjunction with the insufficiencies of PDS's WAN, make this scenario unlikely to be successful.

No details are available which systems and / or data are replicated between the PO and Legon DCs. Decision criteria when a failover will take place are to a certain extend defined in the BC / DR documentation (see above).

End-users can continue working from their usual workplace on systems that have failed over to Legon after manual changes are carried out by the ICT BU.

3.13   Monitoring and Auditing

3.13.1   Monitoring

PDS uses Mikrotik's The Dude (https://mikrotik.com/thedude) as network monitoring solution that can automatically scan devices within specified subnets, enables to draw and layout a map of networks, can monitor services of devices and can send alerts in case devices or services experience problems. The solution supports mainly Mikrotik's devices (switches, routers, etc) with limited support for devices of other technologies (e.g. Servers, OSs, applications) and vendors.

Furthermore, the ICT BU deployed WhatsUp Gold (https://www.whatsupgold.com) to monitor its server environment.

None of the above monitoring solutions are configured to send notifications when warning / critical thresholds are reached or devices are unavailable.

Reports are regularly provided to Executive as part of the quarterly internal SLA review meetings. Samples of such reports have not been provided by the ICT BU.

No dashboards have been setup showing live performance of the essential parts of the ICT environment.

No reports have been provided listing devices, servers and other objects that are monitored by either of the above solutions. Availability and utilisation reports were also not provided.

IT objects are monitored as listed in below table.

Table 13: Monitored Objects

Category	Objects	Type of Monitoring	Details
Facilities (Gen., UPS, etc.)	N/A		
Network	N/A		
Servers	N/A		
Virtual Environment	N/A		
Storage	N/A		
Server Operating Systems	N/A		
Other (e.g. Services, AD, DNS)	N/A		
Information Systems	N/A		
Workstations / Peripherals	N/A		

3.13.2   Logging

PDS does not use centralised logging systems (e.g. Syslog) or system auditing solutions that monitor access to and use of ICT devices (switches, routers, servers, storage devices, etc.), OSs, Applications (AD, SQL Server, Exchange, Information Systems, etc.) and data (e.g. files, databases).

Local logging is enabled for:

▪ Network devices using functionality of "The Dude";

▪ Business Applications; and

▪ Windows Servers / Workstations using the standard Windows Eventlogs.

Logs are not regularly checked.

3.13.3   Auditing

3.13.3.1 Active Directory Auditing

Except for successful/failed logins no further policies are configured to audit the Active Directory of PDS.

Table 14: AD Auditing Policies

Policy Name	Applied to System/Object	Purpose
Login Success/Failure	Users	Monitor successful / failed logins of users

PDS does not use any dedicated tools to audit its Active Directory.

3.13.3.2 Exchange Auditing

PDS does not use any dedicated tools to audit its MS Exchange environment.

3.13.4 Vulnerability Scans

PDS has never carried out any vulnerability scans and has no appropriate tools in place.

3.13.5 Penetration Tests

PDS has never carried out any penetration tests and has no appropriate tools in place. PDS has never contracted an external, certified vendor to carry out a penetration test.

3.14 Management Systems

3.14.1 Inventory/Asset Management

PDS has an IT Asset Management (ITAM) system (part of iTop Service Desk) deployed, which it uses to capture IT asset information manually. Furthermore, some IT asset information is maintained in an Excel spreadsheet.

PDS has neither a Software Inventory nor a Software License Tracking solution in place.

3.14.2 Configuration Management Database

PDS has no Configuration Management Database (CMDB) solution in place to track IT asset configuration and related information.

3.14.3 Data Centre Infrastructure Management

PDS deployed OpenDCIM (https://www.opendcim.org) a free, web based Data Centre Infrastructure Management (DCIM) application that provides complete physical inventory (asset tracking) of devices placed in a DC, support for multiple rooms (Server Rooms / Data Centres),

management of the three key elements of DC capacity management (space, power, and cooling), fault tolerance tracking (e.g. power down simulation), computation of centre of gravity for each cabinet, template management for devices, tracking of cable connections within each cabinet and for each device, archival functions for salvaged / disposed equipment, and integration with intelligent power strips and UPS devices.

No reports or diagrams from OpenDCIM were provided and it is therefore unknown to what extend the systems is used and in how far the data maintained in OpenDCIM is up-to-date.

3.14.4 Software Distribution, Installation & Configuration

3.14.4.1 Operating System Deployment

PDS does not use solutions for automated Operating System deployments (installations).

3.14.4.2 Software / Application Deployment

PDS does not use solutions for automated Software / Application deployments (installations).

3.14.5 Update/Patch Management

3.14.5.1 Network Devices

PDS stated that network devices are updated and are on the latest firmware. However, evidence established from the inventory lists show that Mikrotik devices firmware versions vary substantially.

3.14.5.2 Windows

The ICT BU states that it uses Kaspersky software to deploy Anti-Virus patches and upgrades to Windows Servers and Workstations Operating Systems and applications. However, no evidence was provided that successful, regular and timely patching takes places.

It appears as if PDS is using MS WSUS for updating / patching Windows OSs and applications but no further information was made available.

3.14.5.3 Linux/Unix

A centralised update solution is not deployed; patches are applied manually.

3.14.6 Network Management

3.14.6.1 IP Address Management

PDS does neither use a proper IP Address Management (IPAM) tool nor an appropriate IPAM spreadsheet to manage IP address allocation. A basic spreadsheet maintained by the ICT Network Division exists that documents some IP configurations of the PDS network. However, the document was not provided due to security concerns expressed by the ICT BU (expose IP addresses to 3rd parties).

3.14.6.2 Network Configuration & Backup Solutions

PDS does not use any tools for tracking and automating network device configurations.

Backups of Mikrotik device configurations are carried out with Mikrotik's The Dude software. Information how far configurations of non-Mikrotik devices (e.g. HP, TrendNet, etc.) are protected against losses were not made available.

3.14.7 Mobile Device Management

PDS does not use any solutions to manage Mobile Devices accessing its network.

3.14.8 AD Management

ManageEngine ADManager Plus (https://www.manageengine.com/products/ad-manager) is deployed to assist with day-to-day AD management activities.

3.14.9 Remote Desktop Management

The ICT BU uses a remote desktop management software named NetSupport Manager to manage centralised access to PDS's workstations and servers.

3.14.10 Password Management

PDS maintains system passwords of its IT environment in an Excel spreadsheet. No centralised, secured password management solution has been deployed.

3.15   Budget

Summarised budget figures as requested in below tables were provided as depicted below.

Table 15: ICT Budget – Operation Expenditures 2018

Account Category	Budget [GHS]	Comments
Medical Expenses	148 000	
Overnight Expenses	245 120	
Account Category	**Budget [GHS]**	**Comments**
Honorarium	201 197	
General/Sundry Expenses	14 347	
Hotel Expenses	68 016	
Meals & Lunch Allowances	31 732	
Local Travelling Expenses	4 227	
Staff Vehicle Maintenance	49 920	
Risk Allowance	5 833	
Cleaning Expenses	22 189	
License And Subscriptions	26 360 649	
New Service Connection Expenses	2 400	
Long Service Award	20 960	
Kilometric Allowance	136 978	
Tools & Other Equipment	442 350	
Staff Training (Foreign)	2 117 922	
Staff Training (Local)	1 968 000	
Funeral Expenses	7 112	
Repairs - Computer Related Item	571 900	
Maintenance Of Equipment	5 095 265	
Maintenance Of Staff Bung.	5 000	
Printing & Stationery	18 600	
Post & Telephone	46 400	
Communication Expenses	6 980 000	
News Papers & Periodicals	24 000	
Professional & Related Fees	18 800	
Overseas Travel Expenses	120 000	
TOTAL	**44 607 037**	

Table 16: ICT Budget – Capital Expenditures 2018

Project – Sponsor	Budget [GHS]	Comments
Computers & Related Equipment (Directorates & regions)	33 768 684	Refer to ICT Budget attached hereto
MiDA Projects		
GIS	1 156 700	Office/Stationary, Visits, Training, Workshops

Software licensing & Hardware	17 724 000	For GIS extension to remaining regions	
OMS	334 636	Office/Stationary, Visits, Training, Workshops	
ERP	466 248	Office/Stationary, Visits, Training, Workshops	
Grid Modernisation – SCADA	257 916	Office/Stationary, Visits, Training, Workshops	
ICT Related Projects			
Improve ICT Service Management	312 400	Develop and Implement Enterprise Architecture and Enterprise Risk Management and Business Continuity Plan	
Improve Strategy Management	10 000	Directorate durbars, meetings	
Create ICT Awareness and train users	4 000	Workshops & Training	
Deliver according to SLAs to keep Users satisfied	606 000	Workshops	
Provide Implementation Support for GIS	600 000		
Provide Implementation Support for Outage Management System	641 250		
Implement Document Management System	500 000		
Project – Sponsor	**Budget [GHS]**	**Comments**	
Implement Online Payment for Smart Prepaid Systems	200 000		
Provide Implementation Support for ERP	262 000		
Cross Train IT staff for better Service delivery	60 500		
CMS DR Site Upgrade	41 255		
Set up a mirrored HIS database outside SCADA system	156 200		
Improve ICT infrastructure	3 450 000	Fibre, LANs, VoIP, WAN (SCADA, CSC), etc.	
TOTAL	**60 551 789**		

3.16   Operational Architecture – Planned Changes

No information regarding projects that implement changes to the operational architecture of PDS's ICT BU were made available.

Table 17: Operational Architecture – Planned Changes

Project	Timeline	Budget [US$]	Completed [%]
N/A			

4. Information Systems

This section provides information regarding Information Systems, structured into Software licensing, Business Applications, the Messaging Infrastructure, Voice-over-IP Systems, Database Management Systems, Document Management Systems, Intranets, Websites, and cloud-based systems.

4.1 License Agreements

The table that follows lists the software license agreements and purchases as provided by the ICT BU. The table is in all likelihood incomplete since no data was provided for some systems in use at PDS, such as the Infor SunSystems solution.

Table 18: License Agreements / Purchases

Vendor	Line Items (Products)	Type	Renewal Start	Renewal End	Qty
Microsoft	Windows Enterprise per Device	Open License Agreement	01/07/2016	30/06/2018	100
	Exchange 2016 Enterprise User CAL without Services		28/03/2016	31/03/2018	100
	Exchange Server 2016 - Enterprise		28/03/2016	31/03/2018	2
	Exchange Server 2016 Standard User CAL		28/03/2016	31/03/2018	300
	SQL 2008 R2 - Device CAL		10/05/2011	31/05/2013	10
	SQL Server - Standard		10/05/2011	31/05/2013	2
	Windows Server 2008 R2 - Enterprise		21/02/2011	28/02/2013	2
	Windows Server 2008- Enterprise		09/10/2008	31/10/2010	3
	Windows Server 2012 R2 - Standard		20/08/2015	31/08/2017	10
	Windows Server 2008 R2 - Standard		21/02/2011	28/02/2013	1
	Windows Server 2012 – User CAL		20/08/2015	31/08/2017	50
	Windows Server 2008 - User CAL		09/10/2008	31/10/2010	155
NetSupport	NetSupport Manager	Perpetual 1-Year Maint.	01/06/2011	31/05/2012	100
	NetSupport Notify		01/02/2015	31/01/2016	500
IPSwitch	WhatsUp Gold Premium	Perpetual 2 Year Maint.	27/08/2012	24/08/2014	100

Kaspersky	Endpoint Security for Business Kaspersky Anti-Virus for Linux Workstation Kaspersky Anti-Virus for Windows File Servers Kaspersky Anti-Virus for Windows Workstations Kaspersky Anti-Virus for Novell NetWare Kaspersky Anti-Virus for Linux File Server Kaspersky Anti-Virus for Samba Servers Kaspersky Security 10 for Windows Server Kaspersky Endpoint Security for Linux Workstation Kaspersky Endpoint Security for Mac Kaspersky Endpoint Security 8 for Windows (Workstations component)	Subscription	27/07/2017	02/08/2019	400
Vendor	**Line Items (Products)**	**Type**	**Renewal Start**	**Renewal End**	**Qty**
	Kaspersky Endpoint Security 8 for Windows (Servers component) Kaspersky Endpoint Security 10 for Windows (Servers component) Kaspersky Endpoint Security 10 for Windows (Workstations component) Kaspersky Endpoint Security for Smartphone Kaspersky Security for Mobile Kaspersky Anti-Virus 5 for Windows Workstations Kaspersky Anti-Virus for Windows Workstation for R-Style Kaspersky Anti-Virus for Windows Workstation for Aquarius Kaspersky Anti-Virus for Windows Workstation for DEPO Kaspersky Endpoint Security 10 for Mac Kaspersky SafeBrowser for iOS Kaspersky SafeBrowser for WinPhone Kaspersky Endpoint Security 10 for Linux				
Sophos	Enterprise Guard	Subscription	21/03/2018	14/09/2019	Unlimited
	Email Protection				2500
Nakivo	Enterprise Backup & Replication for Hyper-V and VMWare	Perpetual	25/06/2018	9/09/2019	20 Sockets
Comodo	Wildcard SSL for PDSgh.com domain	Subscription	25/08/2018	26/11/2020	n/a
SysAid	SysAid On-Premise Full Edition	Subscription 3 Years			5500 Assets
Oracle	Payroll				6000 Employees
	Performance Management				2000 Employees
	Balanced Scorecard with Oracle BI and Oracle Data Integrator (Two phases)				25 & 25
	Enterprise Asset Management (eAM) eAM Self Service Work Request Financials (GL & Fixed Assets) Inventory				30 30 5 5

Type = Perpetual, Subscription (Annual, Monthly, etc.)

4.2 Business Applications

The section describes the information systems (application) that PDS uses to operate and manage its business. Information requested from and provided by the ICT BU cover general, business related and technical information. A summary of the Business Applications is listed in the table that follows. Details of each Business Application are documented in Annexure 10.3.

Figure 4: Business Systems Diagram
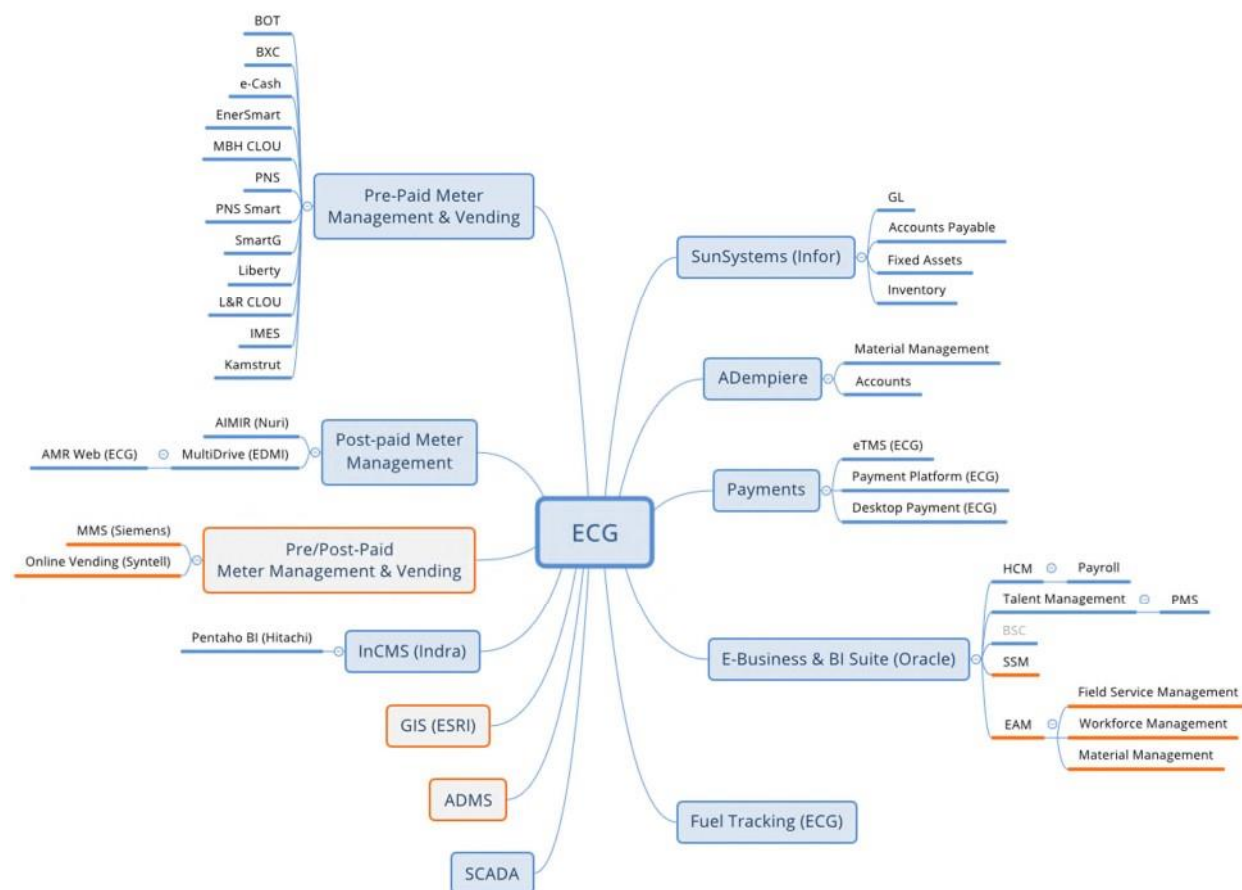
Note: Systems in orange boxes or underlined orange are planned systems (in preparation/ under implementation)

Table 19: Business Applications Overview

System Name	Vendor	Description & Modules	Details
SunSystems	Infor	Financial Management System (FMS) Modules: Fixed Assets, Ledger Accounting, Purchasing Invoice, Inventory Control, Infor Query and Analysis	10.3.1
E-Business & BI Suites	Oracle	The E-Business Suite is an Enterprise Resource Planning (ERP) solution. Modules: Human Capital management (HCM) Payroll, Performance Management System (PMS), Balance Scorecard (BSC)	10.3.2
ADempiere	ADempiere	Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) solution. Modules: Materials, Engineers, Estimators, Transport Requisition, Accounts	10.3.3

InCMS	Indra	The Indra Commercial Management System (InCMS) serves as a platform for all commercial activities in PDS including contracting, billing, meter management, pre- and post-payments, reading of meters, and customer contacts.	10.3.4
Pentaho	Hitachi	Open Source BI to analyse data from InCMS	10.3.5
Pre-Paid Meter Management & Vending Systems			
BOT	BXC	Meter Management and Vending Functions	10.3.6.1
BXC	BXC	Meter Management and Vending Functions	10.3.6.2
e-Cash	Ghana Electrometer	Meter Management and Vending Functions	10.3.6.3

System Name	Vendor	Description & Modules	Details
EnerSmart	Holley	Meter Management and Vending Functions	10.3.7.2
MBH CLOU	Clou Electronics	Meter Management and Vending Functions	10.3.6.4
PNS	N/A	Meter Management and Vending Functions	
PNS Smart	N/A	Meter Management and Vending Functions	
SmartG	N/A	Meter Management and Vending Functions	
Liberty	N/A	Meter Management and Vending Functions	
L&R CLOU	N/A	Meter Management and Vending Functions	
IMES	N/A	Meter Management and Vending Functions	
Kamstrut	N/A	Meter Management and Vending Functions	
Post-Paid Management Systems			
AIMIR	Nuri Telecom	N/A	10.3.6.5
ezViews	N/A	Old AMR	
MultiDrive MTS	EDMI	New AMR	
Engineering Applications			
PSS SINCAL	N/A	N/A	
SCADA	N/A	N/A	
PDS Inhouse Developed Systems			
eTMS	PDS	PoS application used for payment of post-paid (credit meters) and pre-paid (pre-paid meters) bills.	10.3.9.1
Payment Platform	PDS	Receiving of revenue (receipting post-paid bills) web-based platform.	10.3.9.2
Desktop Payment Application	PDS	Used by PDS cashiers for collecting post-paid bills. It is a thick client requiring installation on individual PCs.	10.3.9.3
Fuel Tracking System	PDS	Tracking fuel usage of PDS fleet	10.3.9.4

AMR Web App	PDS	Access data from Multi-Drive System MTS	
Planned & Upcoming Business Applications			
Geographical Information System (GIS)			
Hexagon	N/A		
Meter Management System (MMS)			
Siemens	MindSphere MindApp: EnergyIP	EnergyIP is an energy/gas/water-specific extension to Siemens' MindSphere service offering and includes application modules for meter data management, head-end system, consumer data web portal management, demand response and virtual power plant management, prepaid energy management, market settlements, field asset deployment, etc. Modules: Meter Data Management (MDM), UDIS Head-End System (HES), Asset Management Centre (AMC) and an On-Line Vending Platform provided by Syntell (see below).	0
Syntell	S3 Vending System	The Syntell S3 Prepaid Management and Vending system is an online system that utilises equipment and software applications to provide electricity prepaid technologies for local, provincial and national government. The system caters for numerous vending clients, including handheld terminals, PC-based points of sale, scratch cards, cell phones and e-commerce solutions.	0
Advanced Distribution Management System (ADMS) / Outage Management System (OMS)			
N/A	N/A	An ADMS includes functions that automate outage restoration and optimize the performance of the distribution grid. An outage management system (OMS) provides the capability to efficiently identify and resolve outages and to generate and report valuable historical information.	10.3.10.3
Enterprise Asset Management System (EAM)			
E-Business Suite – EAM Module	Oracle	Enterprise Asset Management (EAM) involves the management of the maintenance of physical assets of an organisation throughout each asset's lifecycle.	10.3.10.4
System Name	**Vendor**	**Description & Modules**	**Details**
Scorecard and Strategy Management			
BI Suite – SSM Module	Oracle	Oracle SSM replaces Oracle BSC for which Oracle announced end-of-live in Sep. 2017. SSM is part of Oracle BI Suite.	10.3.2

4.3 Messaging Systems

PDS's messaging service is based on Microsoft Exchange Server 2013 having the Hub, Client Access (CAS) and Mailbox roles deployed in single server mode. The Exchange version of the Edge role deployed in the DMZ is unknown.

PDS operates in total two Exchange servers, having both the Hub, Client Access (CAS) and Mailbox roles installed. Both servers are setup as a DAG (Database Availability Group) cluster. Replication and synchronisation of the databases takes place from between the two Exchange serves. DNS Round Robin is configured for the Exchange servers. NMBF has several databases (as listed later on) on that replicate from one server to another.

The Exchange messaging service provisions:

- Access to collaborative services that Exchange offers in the 2013 version, including mail (internal/external), calendaring, notes, tasks and contacts;

Database	Storage Group	Size [GB]	Active Server	Passive Server	Purpose & Comments
Archive Database	N/A	314	N/A	N/A	Archive of all mails over three years Storage limits: No limit

| Inactive Accounts | N/A | 18.7 | N/A | N/A | Contains mailboxes of inactive accounts |

- Public Folder space for shared collaborative services (not in use by PDS);

- Access to the user's mailbox via MAPI (Outlook), SMTP, IMAP4, RPC over HTTP, ActiveSync and via the Web (Outlook Web Access).

A mail flow diagram could not be provided by the ICT BU.

PDS deems the messaging service as important therefore users require access to e-mail functionality internally and externally. However, the PDS users generally have the perception that the network and email is not reliable and therefore, often use external mail providers such as Yahoo and Google, which raises security, confidentiality and policy concerns in general.

Remote access to e-mail via Outlook Web Access is available at https://mail.PDSgh.com using a public SSL Wildcard Certificate from COMODO CA Limited (expires on 20 November 2020).

4.3.1 Exchange Databases and Storage

Table 20: Exchange Databases

Database	Storage Group	Size [GB]	Active Server	Passive Server	Purpose & Comments
					Storage limits: No limit
PROMBX02	N/A	795	N/A	N/A	Contains user mailboxes
PROMBX04	N/A	19.1	N/A	N/A	Contains user mailboxes
PROMBX06	N/A	4.75	N/A	N/A	Contains user mailboxes

Storage locations of the two Exchange servers are configured as follows.

Table 21: Exchange Databases

Server	Partition	Disk Drive	Size [GB]	Comment
N/A	System	C:	240	98.5 GB free space available
	Database	E:	1 400	1.12 TB free space available
	Logs	F:	292	282 GB free space available
N/A	System	C:	300	63.7 GB free space available
	Database	E:	1 390	532 GB free space available
	Logs	F:	299	252 GB free space available

4.3.2 Exchange Public Folders

Table 22: Exchange Public Folders

Folder Name	Purpose & Comments
None	

4.3.3 Exchange Policies & Settings

Table 23: Exchange Policies & Settings

Policy	Settings / Description
Accepted Domains	PDSgh.com electricitygh.com (DNS cannot be found)
Remote Domains	N/A
Send Connectors	Outbound mail
Transport Settings	MaxSendSize =50MB MaxReceiveSize = 50MB
Domain Controllers / GCs	PROPPPWDC02, TMAPPPWDC01, ASWPPPWDC01, ELVPPPWDC01, ACEPPPWDC01, WSTPPPWDC01, ACWPPPWDC01, VOLPPPWDC01, CENPPPWDC01, PROPPVWDC03, ASEPPPWDC01, ESTPPPWDC01
Outlook Anywhere	mail.PDSgh.com
Owa (Default Web Site)	https://mail.PDSgh.com/owa, Website: Default Web Site Authentication: Basic, FBA Outlook Web App version: Exchange 2013 External URL: https://mail.PDSgh.com/owa
Receive Connectors	HubTransport, FrontEnd Transport
Retention Policy Tags / Policies	Move mails older than 3 years to archive policy Retain Junk Mails for 30 days
Email Address Policies	Default Policy -
Policy	**Settings / Description**
	Email Address Format SMTP Primary: @PDSgh.com Address 2: John.Smith@PDSgh.com X400 Primary: c=GH;a= ;p=PDSExchange;o=Electricity Company of Ghana;

4.3.4 Signature Management

PDS has no signature management solution for MS Exchange deployed.

4.3.5 Mail Archiving

PDS has no dedicated message archiving solution deployed. The built-in functional of MS Exchange is used to archive emails after 1095 days.

4.3.6 Exchange Management and Auditing

PDS has no MS Exchange management or auditing software deployed.

4.4   Voice-over-IP Systems

PDS has deployed Elastix (https://www.elastix.org), based on Asterisks and other open source projects, and AudioCodes (https://www.audiocodes.com) gateway devices to provide VoIP services. The solution is installed at all regional and district offices. Inter-office calls are routed via Elastix; calls to public are routed to the PSTN network.

No external VoIP is used by PDS.

Quality of Service (QoS) is not configured on any network device to ensure guarantees for the voice traffic.

Further details about deployed VoIP devices, phones and radios are contained in Attachment **Error! Reference source not found.**.

4.5   SMS Systems

PDS does not have an internal SMS solution deployed, though PDS uses an SMS service provided by SMSGH (Hubtel).

Some of PDS's metering applications (e.g. NURI) send out notifications to customers. Further, the incident management system sends out notifications to field personnel regarding job assignments.

4.6   Database Systems

PDS has various different versions of Microsoft (MS) SQL Server, Oracle and MySQL deployed on different servers. Incomplete information about the database landscape has been provided by the IUCT BU (see below table).

Table 24: Databases

Hostname	Type	Database Name	Size DB / Log [MB]	Description
N/A	MS SQL Server	N/A	8716 / 0.5	Corporate Intranet
N/A	MS SQL Server	N/A	303196 / 1083	Technical Assets Accra Server
N/A	MS SQL Server	N/A	644979 / 673	Technical Assets Western Server
N/A	MS SQL Server	N/A	340587 / 506	Technical Assets Ashanti Server
N/A	MS SQL Server	N/A	611642 / 506	Technical Assets Eastern Volta Tema.
N/A	MS SQL Server	N/A	116271 / 506	Incident Management Server

4.7   Document Management Systems

PDS has not deployed a Document Management System (DMS). The ICT BU is investigating and testing a DMS solution from Alfresco (https://www.alfresco.com).

4.8 Intranet

PDS is using Microsoft SharePoint to provide an Intranet to its end-users. Each PDS Directorate has its own portal.

Table 25: Intranet Deployments

Portal Address	Host Name	Database Name	Description
N/A			SharePoint Version, Purpose

4.9 Web Sites

PDS hosts itself a public website for the company at http://PDSgh.com and at http://PDSonline.info. Both are from a content perspective identical and neither of the two is secured using the https protocol.

The public website of PDS, published at the above two URLs, has been developed and is maintained inhouse by the ICT BU. The site uses Joomla (https://www.joomla.org) as underlying Content Management System (InCMS) and Oracle MySQL (https://www.oracle.com/mysql) as database system.

A further site is published under http://slt.PDSonline.info/ (PDS AMR Web Application), but no information about the purpose could be provided by the ICT BU.

None of the sites (www and slt) are secured with an appropriate protocol and certificate.

4.10 Cloud Solutions

PDS indicated that using the cloud-based information systems listed in the table that follows, but no further information was provided by the ICT BU.

Table 26: Cloud-based Applications

Name	Provider	URL Address	Purpose
Liberty	Alpha	N/A	Pre-paid vending system
N/A	N/A	N/A	Mobile app hosted in cloud
N/A	Prometeus	http://www.prometeus.net	N/A

4.11 Information Systems – Planned Changes

Reference to Annexure 10.3.10 for more information.

Table 27: Information Systems – Planned Changes

Project	Timeline	Budget [US$]	Completed [%]
Oracle HCM application maintenance	N/A	N/A	50
Oracle Enterprise Asset Management (EAM) implémentation	N/A	N/A	70

Oracle Scorecard & Strategy Management (SSM) Solution implementation – Replacement for existing Oracle BSC solution	N/A	N/A	90
Meter Management System (MMS) – Most likely a solution from Siemens and Syntell (On-Line Vending Platform)	N/A	N/A	N/A
Advanced Distribution Management System (ADMS) / Outage Management System (OMS)	N/A	N/A	N/A
Enterprise Resource Planning (ERP) system	Mid. 2021	N/A	5

5.   Enterprise Services

This section covers Enterprise Services, including Active Directory, Time Synchronisation, Security Solutions, Thin-Client solutions, Load Balancing and Clustering technologies.

5.1   Directory Services

PDS has Microsoft Active Directory (AD) deployed on 11 servers, at the various locations (see Table 28), acting as Domain Controller (DC) based on the MS Windows Server 2008 R2 Operating System. The Domain Controllers also provide internal DNS, DHCP and Certificate services.

Not all workstations and servers (e.g. Pre-Paid systems) are joined to the domain; some are contained in MS Windows workgroups.

5.1.1   Domain Architecture

PDS's Active Directory (AD) environment is using a single forest, dual domain structure, named PDSgh.com (NetBIOS: PDSGH) and PDSgh.net (NetBIOS: N/A). The PDSh.net domain is used solely by the Indra InCMS environment. A trust relationship has been configured between the two domains. Both domains are centrally managed by the ICT BU.

Table 28: Domain Controllers

Domain Controller	OS Name & Version	Directory Role	Location
PROPPVWDC03	MS Windows Server 2008 R2	Secondary	Project Office DC
PROPPVWDC02	MS Windows Server 2008 R2	Primary, GC, Schema Master, PDC, RID, Domain Naming Master, Infrastructure Master	Project Office DC
ELVPPPWDC01	MS Windows Server 2008 R2	Secondary	Head Office
ACEPPPWDC01	MS Windows Server 2008 R2	Secondary	Accra East
ACWPPPWDC01	MS Windows Server 2008 R2	Secondary	Accra West
TMAPPPWDC01	MS Windows Server 2008 R2	Secondary	Tema
ASWPPPWDC01	MS Windows Server 2008 R2	Secondary	Ashanti SBU
ASEPPPWDC01	MS Windows Server 2008 R2	Secondary	Ashanti SBU
CENPPPWDC01	MS Windows Server 2008 R2	Secondary	Central Region
ESTPPPWDC01	MS Windows Server 2008 R2	Secondary	Eastern Region
WSTPPPWDC01	MS Windows Server 2008 R2	Secondary	Western Region

Changes between the DCs are replicated using the built-in mechanism of AD.

Figure 5: AD Structure
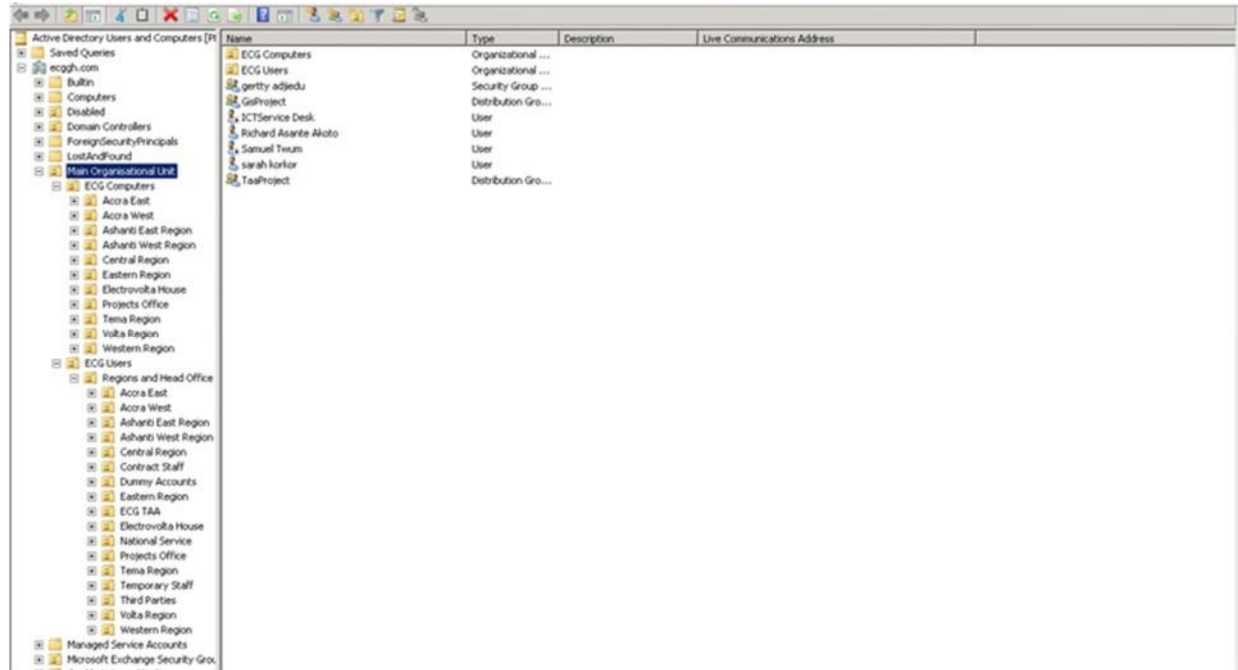
5.1.2   Sites and Subnets

Figure 6: AD Sites & Subnets – Part 1
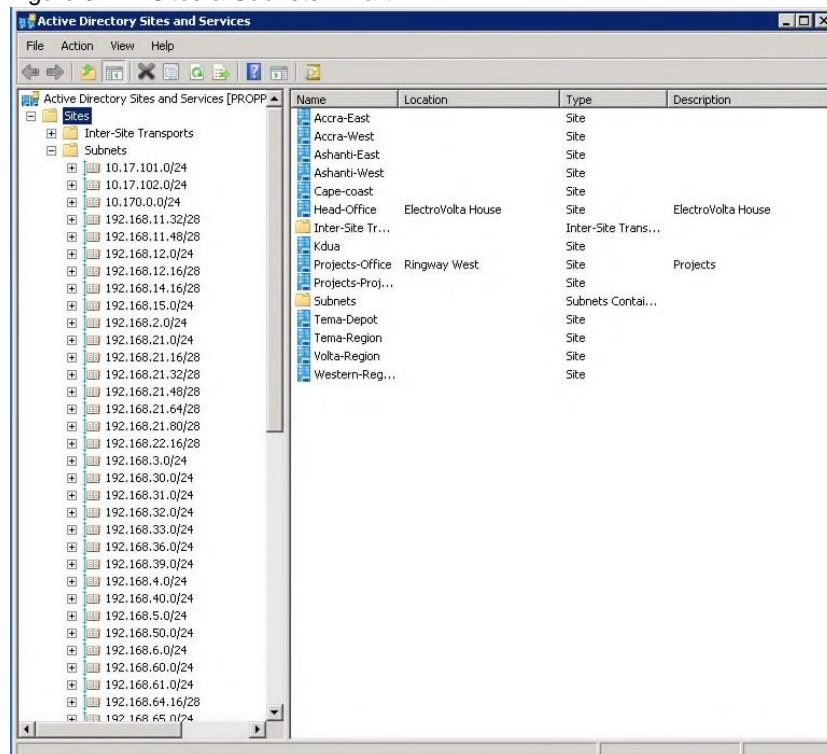
Figure 7: AD Sites & Subnets – Part 2
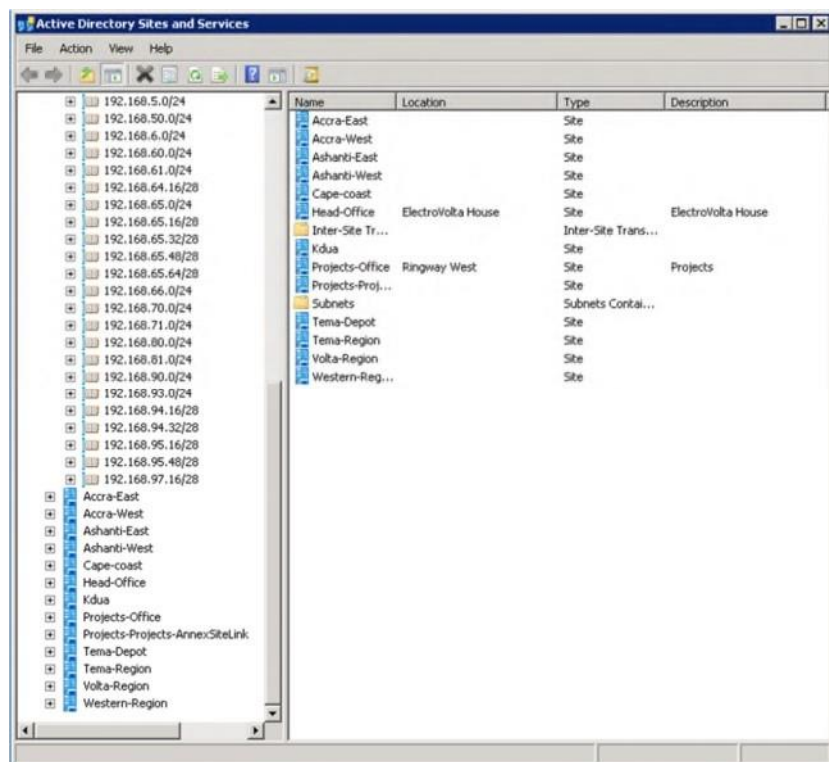
5.1.3   Password Management

Table 29: Password Policies

Scope	Parameter	Configuration
PDSgh.com Domain	Enforce Password History	Yes
	Maximum Password Age	30 days
	Minimum Password Age	00:00:00
	Password History Count	2
	Minimum Password Length	6
	Password Complexity	Yes
	Password Reversible Encryption	No
	Account Lockout Duration	03:00:00
	Account Lockout Threshold	0
	Reset Account Lockout Counter After	N/A

5.1.4   Users and Groups

No strategy for using and nesting of local, global or universal groups has been defined. Limited naming conventions in existence for differentiating the various types of groups.

5.1.4.1   Strategy

PDS does not have a formalised, documented naming strategy for AD objects, such as Users and Groups. User groups are maintained per region (not per Business Unit).

Table 30: AD User & Group Strategy

Group Type	Naming Schema	Email Address	Comments
None			

5.1.4.2   AD Groups

Refer to Attachment **Error! Reference source not found.** for a complete list of AD groups at P
DS.

Table 31: AD Groups excl. Built-in Groups

Group Name	Type	Description	Email Address
See Attachment			

5.1.4.3   Administrative Permissions

Domain Administrators (staff of ICT BU) have normal user accounts for their daily office activities
on the network, and in addition access to a named account with administrative permissions as
listed below. The Domain Administrator accounts are only used to access network resources
when required. However, System Administrator activities are neither specifically logged nor
audited.

Table 32: Domain Administrator Accounts

Directory Account	Full Name	Purpose
PDS KasperskyAdmin	Administrative control over Antivirus servers	N/A
PDS Spam Administrator	PDS Spam Administrator	N/A
Payroll Administrator	Payroll Administrator	N/A
SharePoint Administrator	SharePoint administrator	N/A
Sophos PureMessage Administrator	Sophos PureMessage Administrator	N/A
WSUS Administrators	WSUS Administrators	N/A
Sophos Domain Administrator	Sophos Domain Administrator	N/A

5.1.5   Group Policies

5.1.5.1   Folder Redirection

Folder Redirection policies are not in use at PDS.

Table 33: Folder Redirection Group Policies

GPO Name	Applied to Object Name	Setting	Value
None			

5.1.5.2   File and Printer Mappings

Neither Mapping of File nor Printer Shares via Group Policies are in use at PDS.

Table 34: File / Printer Mapping Group Policies

GPO Name	Applied to User/Group/Device Name	Setting	Value
None			

5.1.5.3   Other Group Policies

For a complete list of Group Policy Objects deployed at PDS refer to Attachment **Error! R eference source not found.**.

Table 35: Other Group Policies

GPO Name	Applied to Object Name	Target	Description
Default Domain Policy	PDSGH	B	RIS, Account Policies
Default Internet Settings	PDSGH	U	Browser settings
Password Policy	PDSGH	U	User password policies
Windows Update Policy	PDSGH	C	Windows Updates
Sophos Certificates	PDSGH	C	
Synology Cloud Station Drive	PDSGH	U	

Target: C=Computer, U=User, B=Both

5.1.6   Login/Startup Scripts

Logon/Startup scripts are not in use at PDS.

Table 36: Logon/Startup Scripts

Filename	Location	Purpose
None		

5.2   Time Synchronisation

PDS has configured NTP server on two routers that synchronise with an external time source. Other edge routers use these two routers to synchronise their time.

Switches and other network devices are not configured to synchronise their time with any source.

Every Active Directory client (whether it's a Windows client or a Windows Server) synchronises its internal clock (time) with a Domain Controller (DC).

All Domain Controllers synchronise their time with the DC holding the Primary Domain Controller (PDC) Flexible Single Master Operations (FSMO) role.

This FSMO DC of PDS synchronises its time with the external source "time.windows.com".

PDS has configured GPOs to synchronise workstations with a time source.

Table 37: Time Synchronisation

Object Type	Hostname	IP Address	Time Source (Hostname or IP Address)
Internal Time Source Routers	N/ A (Edge Router)	N/A	N/A
	N/ A (Edge Router)	N/A	

Other Routers	All other routers	N/A	N/A (Edge Routers)
Switches	All	N/A	N/A
Windows DC FSMO	PROPPPWDC02	N/A	windows.time.com
Windows Domain Servers	All non DCs	N/A	N/A
Windows Workgroup Servers	All non AD member servers	N/A	N/A
Windows Workstations	All	N/A	N/A
Linux/UNIX Servers	All	N/A	N/A

5.3 IT Security Solutions

5.3.1 Firewall and Thread Management

PDS has cccccccc.

A diagram and associated narrative explaining the firewall setup at PDS were not made available. Furthermore, the ICT BU did not provide firewall configuration details or device dumps due to security concerns raised by the responsible personnel.

PDS has a DMZ in place which hosts a web server and the mail gateway.

Table 38: Dedicated UTM/Firewall Devices

Asset ID/Tag	Hostname	DNS Alias(es)	Loopback IP	Make Model	SW Rel.	Location
N/A	N/A	N/A	N/A	Sophos XG Firewall	3.4.5	Accra Project Office

SW Rel. = Software Release of OS / Firmware

Table 39: Current Thread Management Setup

TM Solution	Implemented?	Details (Hostname, IP, Make/Model, Comments)
External Firewall(s)	Yes	Sophos XG Firewall
Internal Firewall(s) - Full DMZ	Yes	N/A
Internal Firewall(s) – Other Zones	Some	To regions
Application Control	No	
Intrusion Detection System	Yes	Available on Sophos Firewall for client workstations and regional servers (secure.PDSgh.com, 172.17.7.7, Sophos XG 750). Note that servers at the DC do not benefit from Sophos.
Intrusion Protection System	Yes	Licensed Component of Sophos Firewall
TM Solution	**Implemented?**	**Details (Hostname, IP, Make/Model, Comments)**
DOS/DDOS Sensor	No	
Anti-Malware	Yes	Available on Sophos Firewall for client workstations and regional servers (secure.PDSgh.com, 172.17.7.7, Sophos XG 750).
Web Filtering	Yes	N/A
Web Application Filtering	Yes	Available on Sophos Firewall for client workstations and regional servers (secure.PDSgh.com, 172.17.7.7, Sophos XG 750).
Reverse Proxy	No	

Note: Information in above table was provided "as is" by the ICT BU

Table 40: UTM Subscriptions

Product	Ser. No.	Reg. Date	Subscription / Support Type	Activation Date	Expiration Date
N/A					

Information regarding the setup of the firewalls, e.g. firewall rules, were not provided by the ICT BU due to security concerns.

Table 41: Firewall Rules

Seq	ID	From	To	Source IP	Dest. IP	Service	Schedule	Purpose	Param.
N/A									

5.3.2 Intrusion Detection / Protection

PDS has neither a dedicated IDS nor an IPS solutions deployed.

5.3.3 DOS/DDOS

PDS has neither a dedicated DOS nor a DDOS solutions deployed.

5.3.4 Proxy Servers

PDS has no dedicated proxy servers deployed to cache incoming Internet.

5.3.5 Reverse Proxy and Web Application Filters

PDS has neither reverse proxy servers nor a dedicated Web Application Filter (WAF) solution deployed.

5.3.6 Anti-Virus Solutions

The "Kaspersky Endpoint Security Suite 10", version 10, is employed by PDS to protect against malware / virus intrusions.

The Administration Kit is installed on server SRV-UPDATE. PDS does not have any Anti-Virus Signature Update Distribution servers deployed in addition to the main Anti-Virus Management Server.

Table 42: Anti-Virus Solutions

Manufacturer	Software Name	Version	Admin. Server	IP Address	Add-Ons
Kaspersky	Endpoint Security for Business Advanced	10.4.343	PROPPVWKS02	N/A	None

The ICT BU verifies on a daily basis that AV software and databases are up-to-date on all servers and workstations.

According to the ICT BU all workstations and servers of PDS are protected (have Anti-Virus clients installed). However, the screenshot reports of Kaspersky that follow show that for several workstations the agent is not installed, not running or that updates are not up-to-date.

No information was provided for servers managed by Kaspersky. Furthermore, the ICT BU refused to provide a screenshot of the Kaspersky Dashboard (Statistics) or any other reports motivated with security reasons.

Figure 8: AV Update Status – Workstations
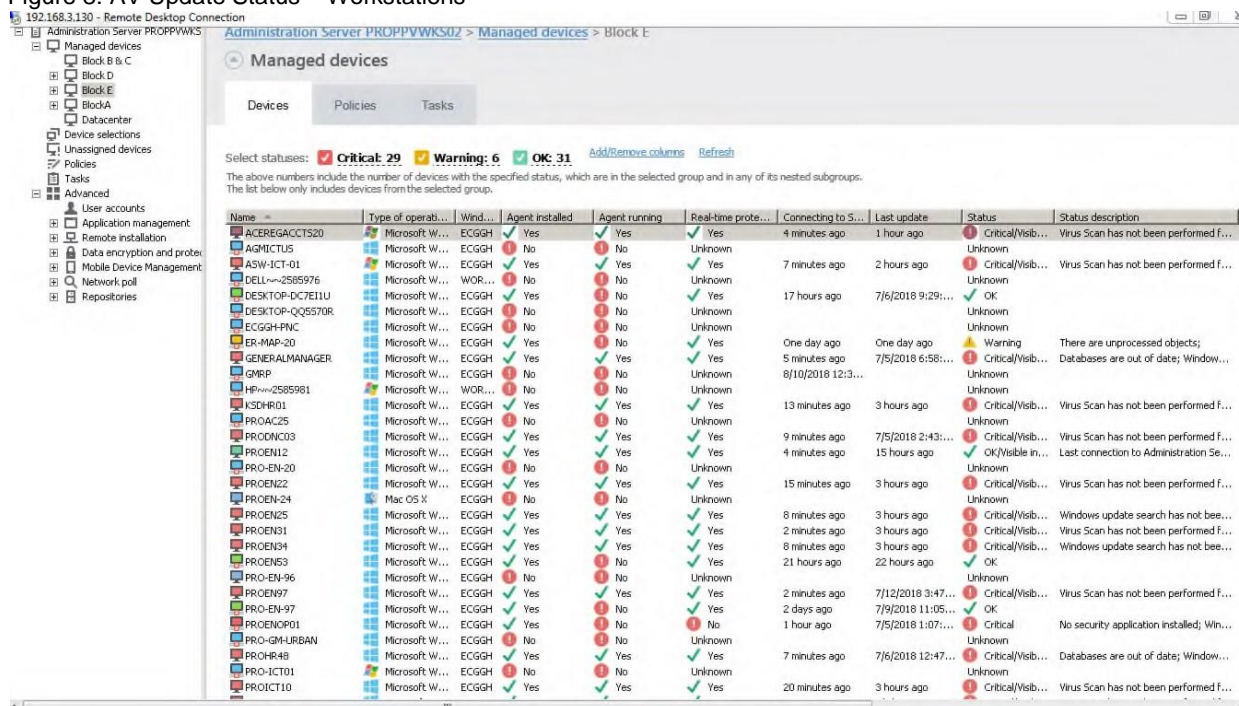
Figure 9: AV Update Status – Servers N/A

Table 43: AV Distribution Servers

Hostname	IP Address	Location	Comments
proppvwks02	N/A	Accra Project Office	
dansomankaspsvr	N/A	Accra Project Office	Temporary Virtual Machine to replace faulty Server for Accra West Region and its district computers.
N/A	N/A	Accra Head Office	
acepppwks01	N/A	Accra East Regional Office	Accra East Kaspersky Server for its region and District office computers.
acwpppwks01	N/A	Accra West Regional Office	
tmrpppwks01	N/A	Tema Regional Office	Tema Regional Kaspersky Server for regional and district office computers.

aerpppwks01	N/A	Ashanti East Regional Office	Ashanti SBU initially existed as two different regions hence the separate servers. They each serve districts that existed under them.
awrpppwks01	N/A	Ashanti West Regional Office	Ashanti SBU initially existed as two different regions hence the separate servers. They each serve districts that existed under them.
cenpppwks01	N/A	Central Regional Office	Central Region Kaspersky Server for regional and district office computers.
erpppwks01	N/A	Eastern Regional Office	Eastern Region Kaspersky Server for regional and district office computers.
wstpppwks01	N/A	Western Regional Office	Western Region Kaspersky Server for regional and district office computers.
volpppwks01	N/A	Volta Regional Office	Volta Regional Kaspersky Server for regional and district office computers.

5.3.7 Mail Filtering and Anti-Spam

The solutions listed below are employed by PDS to protect against email spam intrusion. No AntiSpam solution is setup on the Exchange mailbox servers.

Table 44: Anti-Spam Solutions

Manufacturer	Software Name	Version	Hostname	IP Address
Sophos	Sophos Email Security	5.4.1	N/A	N/A
Sophos	Sophos UTM 9 Virtual Appliance	9.510-5	PDSfw	N/A

5.3.8 Network Access Protection

PDS has not implemented any Network Access Protection or Control (NAP or NAC), 802.1X authenticated wired / wireless access or central network policy management with RADIUS server and proxy support.

No details are known if and how PDS has implemented MAC filtering for its WLANs.

5.3.9 Certificate Management

Table 45: Certificate Solutions

Manufacturer	Software Name	Version	Hostname	IP Address	Certificate Type
Microsoft	Windows Server Certificate Service	2008 R2	N/A	N/A	Internal

5.3.10 Encryption

PDS's applications do not utilise encryption to communicate or exchange data between client and server.

Table 46: Data Encryption

Client Software	Server Software	Comments
None		

5.4 Thin-Client Solutions

PDS uses Citrix as Thin-Client solution to provide access to the InCMS application.

Table 47: Thin Client Solutions

Solution	Version	Hostname(s)	IP Address(es)	Comments
Citrix	6.5	Prompphy01	N/A	Only for InCMS users
Citrix	6.5	Prompphy02	N/A	Only for InCMS users

5.5 Load Balancing and Cluster Solutions

PDS does not use any load balancing or clustering solutions.

Table 48: Cluster Solutions

Solution	Version	Cluster IP	Hostname(s)	IP Address(es)	Purpose
None					

PDS does not use any load balancing solutions.

Table 49: Load Balancer Solutions

Solution	Version	LB IP	Hostname(s)	IP Address(es)	Purpose
Citrix NetScaler	N/A	N/A	N/A	N/A	InCMS application

5.6 Enterprise Services – Planned Changes

Table 50: Enterprise Services – Planned Changes

Project	Timeline	Budget [US$]	Completed [%]
Commission Telephone System at twenty offices	N/A	N/A	60
Data Centre & Communication Network (DCCN) – For details refer to Attachment **Error! Reference source not found.**	2019	N/A	5

6.   Facilities Infrastructure

This section describes the physical facilities such as Data Centres, Computer/Server Network Rooms, as well as associated building aspects, environmental controls, power supply, surveillance and physical security.

6.1   General

During the ICT environmental review activities missing and/or inconsistencies among asset tag names and device/network identifiers were noticed. Due to the absence of a naming and labelling policy, we are thus unable to determine "authoritative" names/IDs for some of the equipment currently deployed in PDS's IT environment.

It is advised to fix these inconsistencies after the development of the respective policy, guiding asset names and equipment identifiers throughout PDS's ICT landscape. However, at this point in time it must be noted that asset names, host names, and other device identifiers may not be accurate. Where possible, device locations and equipment make/models have been added to this report in order to assist with an unambiguous identification of these assets.

Findings established (with focus on facilities) during the site visits to the regional and district offices are outlined below:

▪ The rooms reserved to house central ICT equipment (Computer/Server/Network Room) often contain combustible material, such as wooden furniture and packing material, usually have wooden doors with locks that do not close automatically, have no access control system in place, mostly have windows (some protected with burglar bars), sometimes have wooden or board walls, have no emergency exits, and none of the rooms have false floors or ceilings.

▪ Most rooms have one or more cabinets/racks of different sizes. None of the cabinets are locked, the doors are often standing open with the key inside the lock, and have no fans, environment sensors or access control systems installed inside the cabinets.

▪ ICT equipment is often not mounted properly within cabinets (e.g. placed on wooden shelves) and in most cases the equipment is not properly labelled / tagged. Data and power cabling inside and outside the cabinets is in most cases in disarray and not properly labelled.

▪ The power supply for the ICT equipment is usually linked to the normal office power grid with no dedicated distribution board and insufficient or absent earthing. Most rooms have UPSs of which a few are not in working order, no UPS is monitored, and none of the locations have generator backup for their Computer/Server/Network rooms (some have inverters with batteries).

▪ With the exception that most rooms have smoke sensors installed but not connected to a central environment monitoring system (sensor only beeps in the event of smoke outbreak), none of the rooms or cabinets have proper environment monitoring systems with smoke, heat, humidity, temperature and access control sensors installed.

- The rooms usually have a single Air Condition installed which is unprotected against power failures. In some cases, the Air Condition is not working. No information could be obtained if and when the fire extinguishers are serviced. Inspection cycles for the Air Conditions vary from monthly to twice per annum, but in many cases, it is unknown when inspection and service takes place.

- None of the rooms have fire suppression systems installed, a few have a fire extinguisher in the room, mostly fire extinguishers are located in the passages of the building and in some instances no fire extinguishers could be found. No information could be obtained if and when the fire extinguishers are inspected and serviced.

- Except the room in Koforidua, no other room in the district and regional offices is protected with an access control system.

- Except the room in Kasoa North, no other room is monitored by a CCTV system.

- None of the rooms have emergency lightening, emergency communication or safety signage installed.

For further information about the Data Centres and Computer/Server Network Rooms offices refer to the Attachments 12.3, 12.4, 12.5 and 12.6

With the exception of the Project Office DC and the Legon Data Centre, PDS has not provided information regarding the facilities infrastructure of any other site. Available information for other business locations than the Project Office and Legon DR Site, documented in this section, has been collected during the sites visits of the Consulting team.

6.2   Data Centres, Computer/Server/Network Rooms and Cabinets/Racks

PDS has three main Data Centres, the primary DC located at the Project Office site, a second DC at the Legon District Office (~13 km distance from PO site) and a third DC, currently under construction, at the Ashanti SBU Head Office in Kumasi (~240 km distance from PO site), targeted to be the future DR site of PDS.

The primary and secondary DCs do not host the same type of equipment and setup (e.g. different servers). The two DCs are interlinked by a fibre link. PDS currently uses the Legon DC as DR site for some of their critical systems and data.

Table 51: Data Centres and Computer/Server/Network Rooms

Location / Building / Floor/ Room No. / Name	Type	Room Size W x L x H [m]	Walls	False Floor / Ceiling	Doors	Windows	Emergency Exit
Projects Office / Block A / 2nd Floor / DC	Room w. Cabinets	N/A	Bricks	Yes / No	Metal	None	No
Legon DR site	Room w. Cabinets	10 x 4	Bricks	No / Yes	Metal	None	No
For information about the other offices that were visited refer to Attachments **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**							

Photos of the facilities including cabinets and racks located in the Data Centres and Computer/Server/Network Rooms and the various, visited buildings / offices of PDS are documented in Attachment **Error! Reference source not found.**, **Error! Reference source not fo und.** and **Error! Reference source not found.**.

Figure 10: Floor Layout – Project Office Data Centre
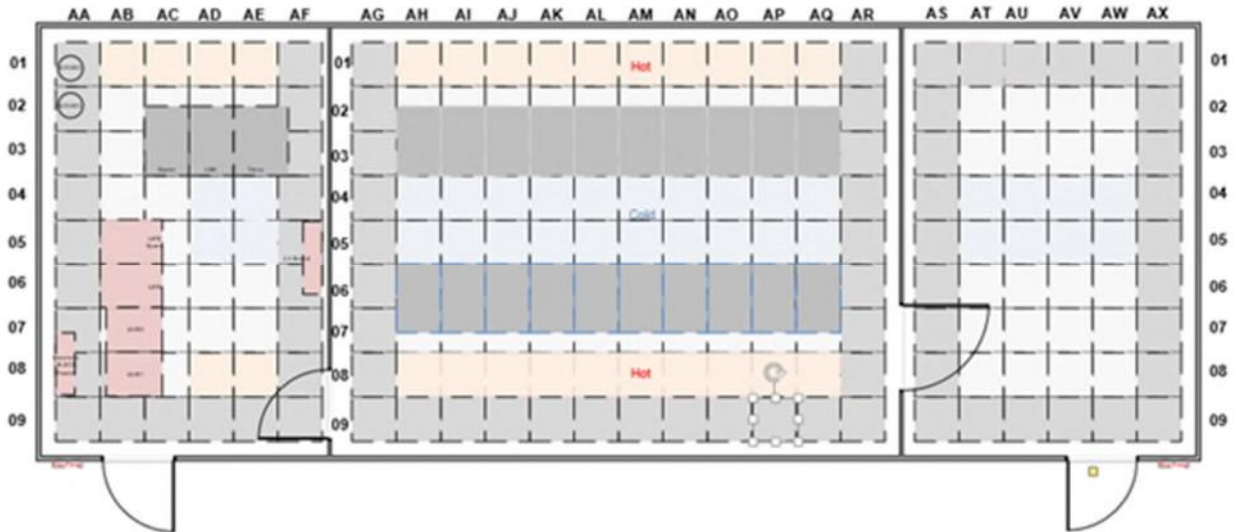
Figure 11: Floor Layout – Legon DR Site Data Centre
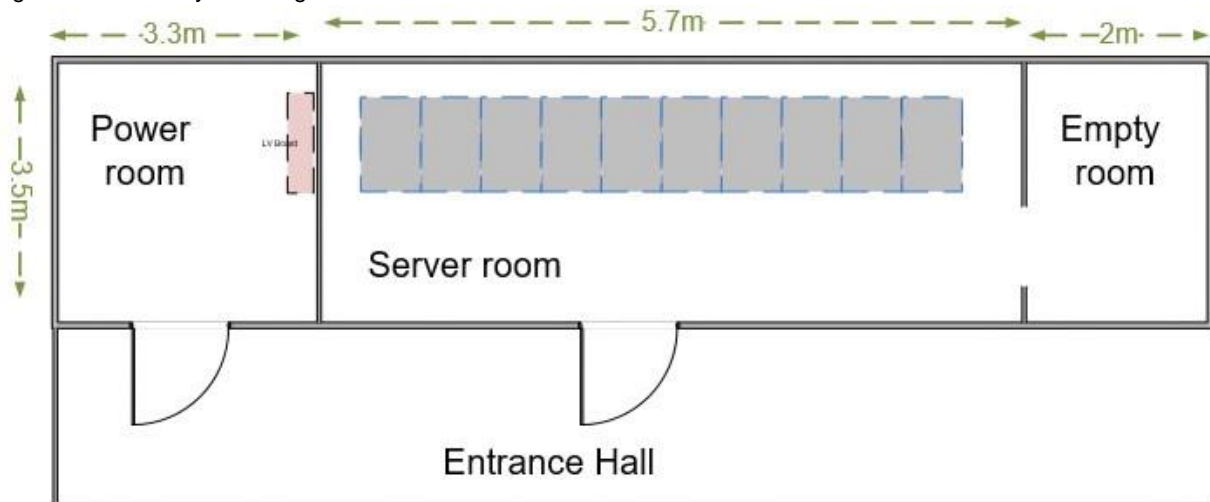
Figure 12: Floor Layout – Kumasi Data Centre
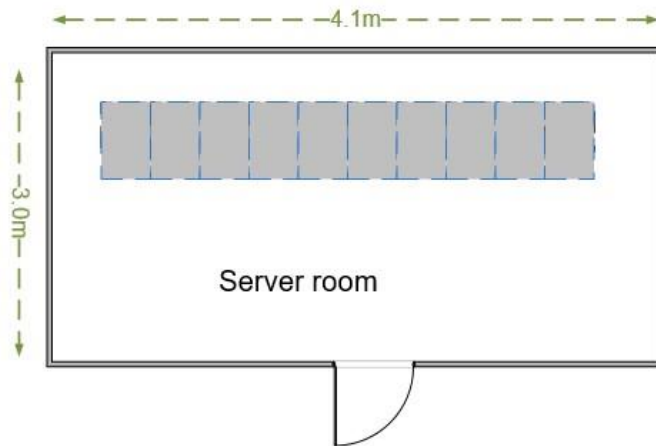
Figure 13: Floor Layout – Other Computer/Server/Network Rooms N/A

Table 52: Cabinets / Racks

Location / Building / Floor/ Room No. / Name	Cabinet Name / Type	Purpose	Size	Fans	Device Labelling	Cable Labelling	Cabling Status
Projects Office / Block A / 2nd Floor / DC	UNNAMED, 1st cabinet from right in the utility room, Lockable Glass Door	Core Switches, WAN Routers, Digicon Modems, Firewall	42U	None	No	No	Ok
	UNNAMED, 1st cabinet from right in the utility room, Lockable Glass Door	Switches, Patch panels	18U	None	No	No	Ok
	Rack A1, 1st cabinet from left, Lockable metal door	Servers	42U	None	Yes	Yes	Ok
	Rack A2, 2nd cabinet from left, Lockable metal door	Servers	42U	None	Yes	Yes	Ok
	Rack A3, 3rd cabinet from left, Lockable metal door	Servers	42U	None	Yes	No	Ok
	Rack A4, 4th cabinet from left, Lockable metal door	Servers	42U	None	Yes	No	Ok
	Rack A5, 5th cabinet from left, Lockable metal door	Servers	42U	None	Yes	No	Ok
	Rack A6, 6th cabinet from left, Lockable metal door	Servers	42U	None	Yes	Yes	Ok
	Rack A7, 7th cabinet from left, Lockable metal door	Servers	42U	None	Yes	Yes	Ok
	Rack A8, 8th cabinet from left, Lockable metal door	Servers	42U	None	Yes	Yes	Ok

Location / Building / Floor/ Room No. / Name	Cabinet Name / Type	Purpose	Size	Fans	Device Labelling	Cable Labelling	Cabling Status
	Rack A9, 9th cabinet from left, Lockable metal door	Servers	42U	None	Yes	Yes	Ok
Legon DR Site, 1st Floor Old Block	Rack A1, 1st cabinet from left, Lockable metal door	Switches	42U	None	Yes	Yes	Ok
	Rack A2	Servers	42U	None	Yes	Yes	Ok
For information about the other offices that were visited refer to Attachment **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**							

The ICT BU did not provide any diagrams depicting the cabinet layouts (which devices are mounted where), data cabling diagrams or narratives describing the cabinet / device setup. Table 53: Cabinet and Device Layout

Location – Cabinet Tag / Name	Asset Tag / Hostname	Type	Make / Model	Description
N/A				

6.3 Power Supply

Information related to the power supply situation were only provided for the Project Office and Legon DR site (refer to the tables that follow). The ICT BU did not provide power cabling diagrams for any site.

Table 54: Power Supply

Location / Building / Floor/ Room No. / Name	Cabinet Name	Dedicated Circuit	UPS	Generator
Projects Office / Block A / 2nd Floor / DC	UNNAMED, 1st cabinet from right in the utility room, Lockable Glass Door	Yes	Yes	Yes
	UNNAMED, 1st cabinet from right in the utility room, Lockable Glass Door		Yes	Yes
	Rack A1, 1st cabinet from left, Lockable metal door		Yes	Yes
	Rack A2, 2nd cabinet from left, Lockable metal door		Yes	Yes
	Rack A3, 3rd cabinet from left, Lockable metal door		Yes	Yes
	Rack A4, 4th cabinet from left, Lockable metal door		Yes	Yes
	Rack A5, 5th cabinet from left, Lockable metal door		Yes	Yes
	Rack A6, 6th cabinet from left, Lockable metal door		Yes	Yes
	Rack A7, 7th cabinet from left, Lockable metal door		Yes	Yes
	Rack A8, 8th cabinet from left, Lockable metal door		Yes	Yes
Location / Building / Floor/ Room No. / Name	**Cabinet Name**	**Dedicated Circuit**	**UPS**	**Generator**

	Rack A9, 9th cabinet from left, Lockable metal door		Yes	Yes
Legon DR Site, 1st Floor Old Block	Rack A1, 1st cabinet from left, Lockable metal door		Yes	Yes
	Rack A2		Yes	Yes
For information about the other offices that were visited refer to Attachment **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**				

Table 55: Generators

Location / Building / Floor/ Room No. / Name	Generator Make / Model	Capacity [kVA]	SNMP?	Monitored?
Projects Office	Caterpillar Genset	N/A	N/A	No
	Cummins Power Genset	N/A	N/A	No
Legon DR Site	N/A	N/A	N/A	No
Kumasi DC	N/A	N/A	N/A	No
For information about the other offices that were visited refer to Attachment **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**				

Table 56: AVRs

Location / Building / Floor/ Room No. / Name	AVR Make / Model	Capacity [kVA]	SNMP?	Monitored?
Projects Office	Sollatek AVR	54	N/A	No
	Sollatek AVR	54	N/A	No

Table 57: UPSs

Location / Building / Floor/ Room No. / Name	UPS Make / Model	Capacity [kVA] / Runtime [min.]	SNMP?	Monitored?
Projects Office / Block A / 2nd Floor / DC	APC Smart UPS VT	40 / 60	Yes	Yes
	APC Smart-UPS	2.2 / 5	Yes	Yes
	APC Smart-UPS	2.2 / 5	Yes	Yes
	APC Smart-UPS	3 / 5	Yes	Yes
	APC Smart-UPS	3 / 5	Yes	Yes
	APC Smart-UPS	5 / 30	Yes	Yes
	APC Smart-UPS	5 / 30	Yes	Yes
	APC Smart-UPS	5 / 30	Yes	Yes
	APC Smart-UPS	5 / 30	Yes	Yes
	APC Smart-UPS	5 / 30		
	APC Smart-UPS	5 / 30		
	APC Smart-UPS	5 / 30		
	APC Smart-UPS	5 / 30		

	APC Smart-UPS	6 / N/A		
	HP UPS	7 / N/A		
	Dell UPS	5 / N/A		
Legon DR Site, 1st Floor Old Block	N/A			
For information about the other offices that were visited refer to Attachment **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**				

Figure 14: Power Supply Schematic – Project Office Data Centre

N/A

6.4 Environmental Controls

6.4.1 Environment Monitoring

Information related to environmental controls were only provided for the Project Office and Legon DR site (refer to the tables that follow). The ICT BU did not provide related diagrams or narratives for any site.

Smoke detectors, temperature sensors and humidity sensors and access control are not implemented for the racks/cabinets.

Table 58: Environmental Monitoring

Location / Building / Floor/ Room No. / Name	Cabinet Name	Controller Unit?	Smoke Sensor	Humidity Sensor	Temperature Sensor	Access Control
Projects Office / Block A / 2nd Floor / DC	N/A	N/A	Yes	Yes	Yes	Yes
Legon DR Site, 1st Floor Old Block	N/A	N/A	Yes	No	Yes	Yes
For information about the other offices that were visited refer to Attachment **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**						

6.4.2 Climate Control

Information related to climate control were only provided for the Project Office and Legon DR site (refer to the tables that follow). The ICT BU did not provide related diagrams or narratives for any site.

Two standard Air Conditions are installed in each Server Room. However, they are not set up in fail-over mode, but work simultaneously or a standby unit is activated manually in the event of a failure of the primary Air Condition. The Air Conditions are regularly inspected by a dedicated technical team.

PDS does not have a monitoring / alarm system for the Air Conditions installed at any site.

Table 59: Climate Control

Location / Building / Floor/ Room No. / Name	Cabinet Name	Primary Air Con	Secondary Air Con (as failover)	Inspection Cycle

Projects Office / Block A / 2nd Floor / DC	N/A	Yes	Yes	Daily
Legon DR Site, 1st Floor Old Block	N/A	Yes	Yes	Twice / week
For information about the other offices that were visited refer to Attachment **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**				

6.4.3   Fire Extinguishers and Suppression Systems

PDS has only at the Project Office DC a fire suppression system installed.

Table 60: Fire Suppression Systems

Location / Building / Floor/ Room No. / Name	Suppression System / Type	Inspection Cycle
Projects Office / Block A / 2nd Floor / DC	Inergen Gas Fire Suppression System	6-Monthly
Legon DR Site, 1st Floor Old Block	Unknown Fire Suppression System (unknown if functioning)	N/A
For information about the other offices that were visited refer to Attachment **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**		

No information was provided when fire extinguishers are inspected or serviced.

Table 61: Fire Extinguishers

Location / Building / Floor/ Room No. / Name	Cabinet Name	Extinguisher Type	Accessibility	Inspection Cycle
Projects Office / Block A / 2nd Floor / DC	N/A	None	N/A	N/A
Legon DR Site, 1st Floor Old Block	N/A	Safequip 9kg Class AB Dry Powder	Not Ok	Yearly
For information about the other offices that were visited refer to Attachment **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**				

6.5   Physical Security

6.5.1   Access Control

PDS has in most locations no mechanism (e.g. Magnetic Card, Biometric, etc.) in place to control and monitor access to the Computer/Server/Network Rooms or any of the remote racks. Usually Computer/Server/Network Rooms and various cabinets are protected by security locks only and are not monitored by an access control system. The cabinets in most locations are unlocked and most cabinet doors are standing open.

Visitors to the Data Centres are neither recorded nor equipped with a badge and can access facilities usually accompanied by an ICT BU member.

Table 62: Access Control Mechanisms

Location / Building / Floor/ Room No. / Name	AC Type	AC System	Comments
Projects Office / Block A / 2nd Floor / DC	Fingerprint Reader		Reader at DC door. AC system separate from building AC system. Access is limited to 10 ICT staff members

Legon DR Site, 1st Floor Old Block	Fingerprint Reader (not working)		Reader at DC door. Access is limited to 10 ICT staff members
Location / Building / Floor/ Room No. / Name	**AC Type**	**AC System**	**Comments**
For information about the other offices that were visited refer to Attachment **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**			

6.5.2 Video Surveillance

CCTV systems dedicated to the Data Centre or Computer/Server/Network Rooms are in almost all locations not installed. Available video footage is neither regularly nor randomly inspected by humans, and the cameras are not cleaned at regular intervals.

Table 63: Video Surveillance

Location / Building / Floor/ Room No. / Name	CCTV System & Cameras	Equipment Monitored?	Camera Inspection / Cleaning
Projects Office / Block A / 2nd Floor / DC	CCTV-SYS DS96128 2 cameras at ceiling of main datacentre, 1 at monitoring room ,1 at utility room ,1 at the corridor of entrance and 1 monitoring Generator	All racks are visible from front	N/A
Legon DR Site, 1st Floor Old Block	2 Camera at ceiling, 1 at entrance, 2 at corridor, and 1 at staircase	All racks are visible	N/A
For information about the other offices that were visited refer to Attachment **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**			

6.6 Other

6.6.1 Emergency Lightening, Communication and Signage

Except the Project Office DC, none of the other Computer/Server/Network Rooms is equipped with emergency lighting (e.g. handheld flashlights) and no method for emergency communication exists in the Computer/Server/Network Rooms (e.g. dedicated mobile phone). Further, most of the sites do not feature signage regarding e.g. access restrictions, food/drink limitations, etc. Table 64: Emergency Lighting, Communication & Signage

Location / Building / Floor/ Room No. / Name	Emergency Lighting Type / Position	Signage Type / Position	Emergency Communication	Emergency Exit
Projects Office / Block A / 2nd Floor / DC	Handheld floodlight in locker at door in utility room	Access restrictions Food/drink limitations	Telephone extensions (office landline)	None
Legon DR Site, 1st Floor Old Block	None	Access restrictions Food/drink limitations	Telephone extensions (office landline)	None
For information about the other offices that were visited refer to Attachment **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**				

6.7 Controls

The review in this section determines whether PDS has identified logical, physical and environmental threats to its Data Centres and Computer/Server/Network Rooms, assessed the risk or impact presented by threats, determined the feasibility of implementing controls to address risks, implemented appropriate controls, and re-assesses risks periodically.

The answers in below tables were provided by the ICT BU but could not be validated against the actual status quo. An "empty" response stands for "Not applicable", and when no answer / information was provided, worst-case scenario is assumed.

Summary:

▪ **Project Office DC**: Out of applicable 179 controls (criteria listed in the tables below), PDS complies partially with 11 Controls and does not comply with 65 controls.

▪ **Legon DC**: Only a few controls were answered by PDS. Out of applicable 179 controls, PDS complies partially with 2 Controls and does not comply with 161 controls.

▪ **Kumasi DC**: Not evaluated since the DC is still under construction.

▪ **Other Computer/Server/Network Rooms**: Not evaluated due to missing data.

Legend:

Compliant or Not Applicable	Partially Compliant	Not Compliant

Table 65: Facilities Controls – Data Centre at Project Office, 2nd Floor Block A, Room 206

ID	Security Measure	Response	Comments
	Fire Hazards		
	Construction		
1	Is the server room (Data Centre) in a building constructed of fire-resistant and non-combustible materials	Yes	
2	Is the sub-flooring concrete or non-combustible?	Yes	
3	Is the raised flooring non-combustible?	Yes	
4	Are doors, partitions, and framing made of metal?	Partial	Partitions made of glass and concrete
5	Is all glass in the facility steel-mesh or otherwise reinforced?	Partial	
6	Is the data centre placed far from potential sources of fire such as: cafeterias, power cables, chemicals, etc.	Partial	
7	Does the construction avoid vertical cable conduits which could spread fire?	N/A	Don't know
8	Do computer room walls extend from floor to roof (below the false floor and above the false ceiling)?	Yes	
9	Are exits and evacuation routes clearly marked?	Yes	
	Combustibles		
10	Are paper and other supplies stored outside the computer room?	Yes	
11	Are curtains, rugs, and drapes non-combustible?	Yes	
12	Are caustic or flammable cleaning agents excluded from the data centre?	Yes	

| 13 | Is computer-room furniture metal-only? | *Partial* | *Furniture made of steel, leather, and glass* |
| 14 | Are server-room or media-library safes closed when not in use? | *Yes* | |

ID	Security Measure	Response	Comments
15	Is decoration of the computer room (e.g., posters, company literature, holiday decoration such as Halloween and Christmas streamers) avoided?	*Yes*	
	Storage		
16	Are copies of critical files stored off-site?	*Partial*	*Not all systems are under our management, e.g. metering servers*
17	Are on-site copies of critical files in fireproof safes?	*N/A*	
18	Are disks and tapes coded to show their evacuation priority?	*N/A*	
	Practice Sessions and drills		
19	Are there regular fire drills?	*N/A*	
20	Are operators trained periodically in fire-fighting techniques?	*N/A*	
21	Are operators assigned specific, individual responsibilities in case of fire?	*Partial*	
22	Is the fire detection system regularly tested?	*No*	
23	If yes, how often (frequency)?		*Not applicable*
24	Is the alarm system tested frequently?	*No*	
25	If yes, how often (frequency)?		*Not applicable*
26	Are automatic detection and protection systems regularly inspected by qualified/certified personnel?	*No*	
27	If yes, how often (frequency)?		*Not applicable*
	Detection and Reaction		
	Detection Equipment		
	Do the facilities have equipment for detecting one or more of the following:		
29	Smoke?	*Yes*	
30	Heat / Temperature?	*Yes*	
31	Are any of these detection units mounted inside cabinets of critical system components?	*No*	*For the entire DC but positioned to detect*
	Are smoke detectors mounted:	*Yes*	
33	in ceiling (above suspended tiling)?	*Yes*	

34	under raised floor?	Yes	
35	Does smoke-detection equipment shut down the air conditioning system?	N/A	
36	Is the smoke-detection system tested regularly?	No	
37	If yes, how often (frequency)?		Not applicable
	Alarm Mechanism		
38	Are there several strategically-located stations for initiating a manual alarm?	No	
39	Do the alarm devices report the position of a fire accurately?	No	
40	Do building alarms (linked to systems outside the computer room) sound within the computer room?	Yes	
	Protection equipment		
	Do the facilities have automatic dispersal of a fireextinguishing or retardant agent such as gas:		
42	into main computer room volume?	Yes	
43	above and beneath floors and ceilings?	Yes	
	Have personnel been trained in:		
45	use of the gas system?	No	
46	personal safety measures?	Yes	
47	Do the facilities have dry suppressants?	Yes	
	Do the facilities have manual equipment such as:		

ID	Security Measure	Response	Comments
49	portable extinguishers for electrical and other fires inside the data centre?	Yes	
50	automatic emergency illumination to permit effective operations?	No	
	Reaction planning		
51	Is there easy access to the computer room and related areas by fire-fighting personnel and equipment?	Yes	
52	Can emergency crews reach the building quickly?	Yes	
53	If access is through electrically-controlled systems, can they be operated on battery power during a power outage?	Yes	
54	Are there established procedures for rapidly re-arming detection and fire-protection devices after discharge?	No	
55	Are additional floor-panel removers (suction cups) located next to all extinguishers?	Yes	

	Water		
	Physical Location		
56	Are computer facilities above the local water line?	*Yes*	
57	If not, have sufficient sealing and foundation draining devices been included in building design?		*Not applicable*
	Within the facility		
58	Will sub-floor drainage evacuate water quickly?	*N/A*	
59	Are drains installed on floor above to divert away from computer room?	*Yes*	
60	Is the upper ceiling constructed so as to shunt water away from equipment?	*Yes*	
61	Are water main shutoff valves in clearly marked, secure locations?	*N/A*	
62	Do staff know how to gain access to the water shutoff valves	*N/A*	
	Outside the facility		
63	Is the roof sufficiently sealed and well-constructed to prevent high winds from splitting it open?	*Yes*	
64	Are there sufficient storm drain inlets to accommodate water accumulation during sudden or seasonal rainfall?	*Yes*	
	Climate Control / Air conditioning (A/C)		
	Equipment		
65	Are the BTU ratings of A/C equipment appropriate for peak loads?	*Yes*	
66	Is the A/C system dedicated to exclusive use by the computer facility?	*Yes*	
67	Are A/C ducts from the rest of the building excluded from the computer room?	*Yes*	
68	Is there a backup A/C facility?	*Yes*	
69	Is the compressor remote from the computer room?	*Yes*	
70	Are there temperature-and humidity-monitoring and recording devices in the computer room?	*Yes*	
71	Do specific operations staff have explicit instructions to examine such records and report on deviations beyond the tolerance norm?	*Yes*	
72	Are (A/C) serviced regular?	*Partial*	
73	If yes, how often (frequency)?	*N/A*	
	Electricity		
	Power supply (PS)		

74	Is the local electrical PS reliable?	Yes	

ID	Security Measure	Response	Comments
75	Is there sufficient voltage and amperage to support the equipment when all of it is operating?	Yes	
76	Is there sufficient PS to support simultaneous start-up of all devices?	Yes	
77	Does the data centre have a dedicated PS (separate from all other use in the building)?	Yes	
78	Are the computer room transformer and motor generator enclosed in a wire cage for protection?	No	
79	Is there standby battery power to operate electrically-controlled doors during power failures?	Yes	
80	Does the computerised access-control equipment have battery backup or rapid-acting UPS to prevent loss of configuration during power failure?	Yes	
81	Does the telecommunications equipment have battery backup or rapid-acting UPS to prevent loss of configuration during power failure?	Yes	
82	Is there a standby Generator onsite to power the businesscritical systems?	Yes	
83	Is there an automatic mechanism for shifting to an alternate PS if the primary source is unavailable (e.g. Generator)?	Yes	
84	Is the switchover from primary to secondary source regular tested?	Partial	
85	If yes, how often (frequency)?	N/A	
86	Is the secondary power source (generator) regularly maintained?	Yes	
87	If yes, how often (frequency)?	N/A	
88	Are the UPS regularly maintained?	No	
89	If yes, how often (frequency)?		Not applicable
	Lightening		
90	Is there an emergency lighting system which automatically activates when the main lighting fails?	No	
91	Is the emergency lighting system tested periodically?	No	
92	Are there additional light sources independent of the main PS (e.g., wide-beam battery-operated portable flashlights)?	No	
	Preparedness for civil, man-made, and natural disasters		
	Location		
	Is the facility:		
94	remote from any known major earthquake fault?	Yes	

95	away from a river bed or flood plain?	Yes	
96	far from high-voltage transmission lines?	Yes	
91	far from rail lines?	Yes	
98	far from fuel storage sites or containers?	Yes	
99	in a low-crime area?	Yes	
100	in an area with low fire potential?	Yes	
101	far enough from adjacent structures that disasters in those buildings would not damage your facility?	Yes	
	Construction		
	Is the building sound enough structurally to resist:		
103	wind storms?	Yes	
104	flood damage?	Yes	
105	Are building and equipment properly grounded to prevent lightning damage?	Yes	

ID	Security Measure	Response	Comments
106	Are alternative emergency accesses available for emergency crews and equipment?	No	
	Natural disaster prediction		
	Is there some means to advise personnel of possible natural disasters such as:		
108	wind storms?	No	
109	severe electrical disturbances?	No	
110	sand storms?	No	
	Alternate location		
111	Is there an alternate location for resumption of operations following a disaster?	Yes	
112	Is the alternate location at least 30km away from the main data centre(s)?	Yes	
	Alternate-site Plan		
	Is there an alternate-site implementation plan?	N/A	
114	If yes, has it been approved by facilities personnel?	N/A	
115	If yes, has it been approved by security personnel?	N/A	

116	If yes, has it been coordinated with key user representatives?	*N/A*	
	Access control		
	Identification (ID)		
117	Is access to the computer room restricted to selected personnel?	*Yes*	
118	Is there a photo-badge system for positive identification of authorised employees?	*N/A*	
119	Are there mechanisms to ensure that an ID badge belongs to the bearer?	*N/A*	
120	Is there a file of current photographs of all authorised personnel available for security officers?	*N/A*	
121	Is even a familiar person forbidden access to the computer room without positive ID?	*Yes*	
122	Is a person accompanying a familiar or authorised person prevented from entering the facility without authorization?	*Yes*	
123	Are transient personnel (e.g., equipment service people) checked out of as well as into the data centre?	*Yes*	
124	Are there restrictions on who may receive data files (e.g., tapes, disks) or reports?	*Yes*	
125	Is there a security-clearance procedure to authorise personnel to obtain files or other material from the data centre?	*No*	
126	Are there restrictions enforced on what visitors and staff may bring into or out of the data centre?	*No*	
	Access routes		
127	Are there guards on every street entrance that allow access to the data centre?	*N/A*	
128	Are there control points (e.g., guards or locks or other accesscontrol devices) blocking direct access from any elevator doors?	*No*	
129	Are all exterior windows at or near street level covered with metal grills?	*Yes*	
130	Are electrically-operated doors protected against intrusion by interrupting the local electrical supply (e.g., by cutting wires)?	*Yes*	
131	Is the computer room screened to render it invisible from outside the building?	*Yes*	
132	Are doors to the data centre locked during evening, night, weekend, and holiday shifts?	*Yes*	

ID	Security Measure	Response	Comments
	Visitor control		
133	Is there an organised and enforced visitor control procedure?	*Yes*	
134	Are all visitors required to wear a distinctive identification badge?	*No*	
135	Are all visitors accompanied at all times (except washrooms with a single door)?	*Yes*	

136	Is there a computer room sign-in/out log for all visitors?	*Yes*	
137	Is there a validation procedure to ensure that unwarranted visitors cannot obtain a temporary pass?	*Yes*	
138	Are vendor personnel and consultants checked for valid proof of their affiliation before being granted a pass?	*Yes*	
139	Are vendor personnel and consultants accompanied at all times despite their familiarity to the data centre staff?	*Yes*	
140	Is there a separate room for equipment provided by 3rd parties (e.g. Telecommunication equipment / routers) from an ISP to avoid the need to give access to the data centre for such personnel?	*Yes*	
141	Do all racks/cabinets have their own access control mechanism to limit and monitor access to the racks/cabinets?	*No*	
	Surveillance and other security measures		
142	Are keys, combination locks, and other security devices installed and used to control access?	*Yes*	
143	Is there a round-the-clock watch patrol going through the facility?	*No*	
	Has closed-circuit television (CCTV) been installed to cover:		
145	critical computer equipment?	*Yes*	
146	access routes?	*Yes*	
147	critical storage areas?	*Yes*	
148	critical telecommunications equipment?	*Yes*	
149	Is access to communications equipment (e.g., junction boxes, switches) restricted?	*Yes*	
	Are there restrictions on the introduction into the data centre for:		
151	camera or other photo-recording equipment?	*No*	
152	sound magnetic or other recording devices?	*No*	
153	Are there electric eyes or motion detectors installed in infrequently-used rooms and passageways?	*No*	
154	Are there motion detectors or other intrusion-detecting devices in the false floors and ceilings	*No*	
155	Are all internal doors in the data centre fitted with self-closing mechanisms?	*Yes*	
156	Do all access doors open fully and freely?	*Yes*	
157	Are all doors equipped with sensors to detect and indicate that they are open?	*No*	
158	Can all external doors be locked on command from a single security station?	*No*	
160	Can all internal doors be locked on command?	*No*	

ID	Security Measure	Response	Comments
161	If there is a CCTV system, are there personnel assigned to watch the monitors at all times?	*No*	
162	Are external walls and windows proof against easy access by a saboteur?	*Yes*	
163	Are all emergency exits wired to sound alarms when opened?	*N/A*	
164	Do emergency exit alarms indicate unambiguously which door has been opened?	*N/A*	
ID	**Security Measure**	**Response**	**Comments**
	House Keeping		
	Is the data centre free of:		
166	accumulations of trash?	*No*	
167	surplus or broken furniture?	*No*	
168	tapes, canisters, straps or disk covers on top of drives?	*No*	
169	printouts, newspapers and magazines?	*No*	
170	surplus, disconnected or broken computer equipment?	*No*	
171	Are equipment covers and work surfaces cleaned regularly?	*Yes*	
172	Are floors washed regularly?	*No*	
173	Is carpeting anti-static?	*N/A*	
174	Are all flammable materials (paper, inks, ribbons, boxes) kept to a minimum in the data centre?	*Yes*	
175	Are food and drink absolutely forbidden in the computer room?	*Yes*	
176	Are CCTV lenses regularly cleaned?	*No*	
177	If yes, how often (frequency)?		*Not applicable*
178	Are operator and maintenance manuals stored neatly in an assigned place adjacent to (but outside) the computer room)?	*No*	
179	Is there a prominent notice announcing AUTHORISED PERSONNEL ONLY — OPERATORS MAY NOT ADMIT VISITORS WITHOUT AUTHORISATION.	*No*	

Response: Yes, No, Partial, an "empty" cell (Not applicable) or "N/A" for information is not available

Table 66: Facilities Controls – Legon Data Centre

ID	Security Measure	Response	Comments
	Fire Hazards		
	Construction		

1	Is the server room (Data Centre) in a building constructed of fire-resistant and non-combustible materials	N/A	
2	Is the sub-flooring concrete or non-combustible?	Yes	
3	Is the raised flooring non-combustible?	Yes	
4	Are doors, partitions, and framing made of metal?	Partial	Partitions made of glass and concrete
5	Is all glass in the facility steel-mesh or otherwise reinforced?	N/A	
6	Is the data centre placed far from potential sources of fire such as: cafeterias, power cables, chemicals, etc.	Yes	
7	Does the construction avoid vertical cable conduits which could spread fire?	N/A	
8	Do computer room walls extend from floor to roof (below the false floor and above the false ceiling)?	Yes	
9	Are exits and evacuation routes clearly marked?	Yes	
	Combustibles		
10	Are paper and other supplies stored outside the computer room?	Yes	
11	Are curtains, rugs, and drapes non-combustible?	Yes	
12	Are caustic or flammable cleaning agents excluded from the data centre?	Yes	
13	Is computer-room furniture metal-only?	Partial	Furniture made of steel, leather, glass
14	Are server-room or media-library safes closed when not in use?	Yes	

ID	Security Measure	Response	Comments
15	Is decoration of the computer room (e.g., posters, company literature, holiday decoration such as Halloween and Christmas streamers) avoided?	Yes	
	Storage		
16	Are copies of critical files stored off-site?	Yes	
17	Are on-site copies of critical files in fireproof safes?	N/A	
18	Are disks and tapes coded to show their evacuation priority?	N/A	
	Practice Sessions and drills		
19	Are there regular fire drills?	N/A	
20	Are operators trained periodically in fire-fighting techniques?	N/A	
21	Are operators assigned specific, individual responsibilities in case of fire?	N/A	
22	Is the fire detection system regularly tested?	N/A	

23	If yes, how often (frequency)?	N/A	
24	Is the alarm system tested frequently?	N/A	
25	If yes, how often (frequency)?	N/A	
26	Are automatic detection and protection systems regularly inspected by qualified/certified personnel?	N/A	
27	If yes, how often (frequency)?	N/A	
	Detection and Reaction		
	Detection Equipment		
	Do the facilities have equipment for detecting one or more of the following:		
29	Smoke?	Yes	
30	Heat / Temperature?	Yes	
31	Are any of these detection units mounted inside cabinets of critical system components?	No	Only for the entire DC
	Are smoke detectors mounted:		
33	in ceiling (above suspended tiling)?	Yes	
34	under raised floor?	N/A	
35	Does smoke-detection equipment shut down the air conditioning system?	N/A	
36	Is the smoke-detection system tested regularly?	N/A	
37	If yes, how often (frequency)?	N/A	
	Alarm Mechanism		
38	Are there several strategically-located stations for initiating a manual alarm?	N/A	
39	Do the alarm devices report the position of a fire accurately?	N/A	
40	Do building alarms (linked to systems outside the computer room) sound within the computer room?	N/A	
	Protection equipment		
	Do the facilities have automatic dispersal of a fireextinguishing or retardant agent such as gas:		
42	into main computer room volume?	Yes	
43	above and beneath floors and ceilings?	N/A	
	Have personnel been trained in:		

45	use of the gas system?	N/A	
46	personal safety measures?	N/A	
47	Do the facilities have dry suppressants?	N/A	
	Do the facilities have manual equipment such as:		

ID	Security Measure	Response	Comments
49	portable extinguishers for electrical and other fires inside the data centre?	Yes	
50	automatic emergency illumination to permit effective operations?	N/A	
	Reaction planning		
51	Is there easy access to the computer room and related areas by fire-fighting personnel and equipment?	N/A	
52	Can emergency crews reach the building quickly?	N/A	
53	If access is through electrically-controlled systems, can they be operated on battery power during a power outage?	N/A	
54	Are there established procedures for rapidly re-arming detection and fire-protection devices after discharge?	N/A	
55	Are additional floor-panel removers (suction cups) located next to all extinguishers?	N/A	
	Water		
	Physical Location		
56	Are computer facilities above the local water line?	N/A	
57	If not, have sufficient sealing and foundation draining devices been included in building design?	N/A	
	Within the facility		
58	Will sub-floor drainage evacuate water quickly?	N/A	
59	Are drains installed on floor above to divert away from computer room?	N/A	
60	Is the upper ceiling constructed so as to shunt water away from equipment?	N/A	
61	Are water main shutoff valves in clearly marked, secure locations?	N/A	
62	Do staff know how to gain access to the water shutoff valves	N/A	
	Outside the facility		
63	Is the roof sufficiently sealed and well-constructed to prevent high winds from splitting it open?	N/A	
64	Are there sufficient storm drain inlets to accommodate water accumulation during sudden or seasonal rainfall?	N/A	

	Climate Control / Air conditioning (A/C)		
	Equipment		
65	Are the BTU ratings of A/C equipment appropriate for peak loads?	*N/A*	
66	Is the A/C system dedicated to exclusive use by the computer facility?	*N/A*	
67	Are A/C ducts from the rest of the building excluded from the computer room?	*N/A*	
68	Is there a backup A/C facility?	*N/A*	
69	Is the compressor remote from the computer room?	*N/A*	
70	Are there temperature-and humidity-monitoring and recording devices in the computer room?	*N/A*	
71	Do specific operations staff have explicit instructions to examine such records and report on deviations beyond the tolerance norm?	*N/A*	
72	Are (A/C) serviced regularly?	*N/A*	
73	If yes, how often (frequency)?	*N/A*	
	Electricity		
	Power supply (PS)		
74	Is the local electrical PS reliable?	*N/A*	

ID	Security Measure	Response	Comments
75	Is there sufficient voltage and amperage to support the equipment when all of it is operating?	*N/A*	
76	Is there sufficient PS to support simultaneous start-up of all devices?	*N/A*	
77	Does the data centre have a dedicated PS (separate from all other use in the building)?	*N/A*	
78	Are the computer room transformer and motor generator enclosed in a wire cage for protection?	*N/A*	
79	Is there standby battery power to operate electrically-controlled doors during power failures?	*N/A*	
80	Does the computerised access-control equipment have battery backup or rapid-acting UPS to prevent loss of configuration during power failure?	*N/A*	
81	Does the telecommunications equipment have battery backup or rapid-acting UPS to prevent loss of configuration during power failure?	*N/A*	
82	Is there a standby Generator onsite to power the business critical systems?	*N/A*	
83	Is there an automatic mechanism for shifting to an alternate PS if the primary source is unavailable (e.g. Generator)?	*N/A*	
84	Is the switchover from primary to secondary source regular tested?	*N/A*	

85	If yes, how often (frequency)?	*N/A*	
86	Is the secondary power source (generator) regularly maintained?	*N/A*	
87	If yes, how often (frequency)?	*N/A*	
88	Are the UPS regularly maintained?	*N/A*	
89	If yes, how often (frequency)?	*N/A*	
	Lightening		
90	Is there an emergency lighting system which automatically activates when the main lighting fails?	*N/A*	
91	Is the emergency lighting system tested periodically?	*N/A*	
92	Are there additional light sources independent of the main PS (e.g., wide-beam battery-operated portable flashlights)?	*N/A*	
	Preparedness for civil, man-made, and natural disasters		
	Location		
	Is the facility:		
94	remote from any known major earthquake fault?	*N/A*	
95	away from a river bed or flood plain?	*N/A*	
96	far from high-voltage transmission lines?	*N/A*	
91	far from rail lines?	*N/A*	
98	far from fuel storage sites or containers?	*N/A*	
99	in a low-crime area?	*N/A*	
100	in an area with low fire potential?	*N/A*	
101	far enough from adjacent structures that disasters in those buildings would not damage your facility?	*N/A*	
	Construction		
	Is the building sound enough structurally to resist:		
103	wind storms?	*N/A*	
104	flood damage?	*N/A*	
105	Are building and equipment properly grounded to prevent lightning damage?	*N/A*	

ID	Security Measure	Response	Comments

106	Are alternative emergency accesses available for emergency crews and equipment?	*N/A*	
	Natural disaster prediction		
	Is there some means to advise personnel of possible natural disasters such as:		
108	wind storms?	*N/A*	
109	severe electrical disturbances?	*N/A*	
110	sand storms?	*N/A*	
	Alternate location		
111	Is there an alternate location for resumption of operations following a disaster?	*N/A*	
112	Is the alternate location at least 30km away from the main data centre(s)?	*N/A*	
	Alternate-site Plan		
	Is there an alternate-site implementation plan?		
114	If yes, has it been approved by facilities personnel?	*N/A*	
115	If yes, has it been approved by security personnel?	*N/A*	
116	If yes, has it been coordinated with key user representatives?	*N/A*	
	Access control		
	Identification (ID)		
117	Is access to the computer room restricted to selected personnel?	*N/A*	
118	Is there a photo-badge system for positive identification of authorised employees?	*N/A*	
119	Are there mechanisms to ensure that an ID badge belongs to the bearer?	*N/A*	
120	Is there a file of current photographs of all authorised personnel available for security officers?	*N/A*	
121	Is even a familiar person forbidden access to the computer room without positive ID?	*N/A*	
122	Is a person accompanying a familiar or authorised person prevented from entering the facility without authorization?	*N/A*	
123	Are transient personnel (e.g. equipment service people) checked out of as well as into the data centre?	*N/A*	
124	Are there restrictions on who may receive data files (e.g. tapes, disks) or reports?	*N/A*	
125	Is there a security-clearance procedure to authorise personnel to obtain files or other material from the data centre?	*N/A*	
126	Are there restrictions enforced on what visitors and staff may bring into or out of the data centre?	*N/A*	

	Access routes		
127	Are there guards on every street entrance that allow access to the data centre?	*N/A*	
128	Are there control points (e.g. guards or locks or other accesscontrol devices) blocking direct access from any elevator doors?	*N/A*	
129	Are all exterior windows at or near street level covered with metal grills?	*N/A*	
130	Are electrically-operated doors protected against intrusion by interrupting the local electrical supply (e.g. by cutting wires)?	*N/A*	
131	Is the computer room screened to render it invisible from outside the building?	*N/A*	
132	Are doors to the data centre locked during evening, night, weekend, and holiday shifts?	*N/A*	

ID	Security Measure	Response	Comments
	Visitor control		
133	Is there an organised and enforced visitor control procedure?	*N/A*	
134	Are all visitors required to wear a distinctive identification badge?	*N/A*	
135	Are all visitors accompanied at all times (except washrooms with a single door)?	*N/A*	
136	Is there a computer room sign-in/out log for all visitors?	*N/A*	
137	Is there a validation procedure to ensure that unwarranted visitors cannot obtain a temporary pass?	*N/A*	
138	Are vendor personnel and consultants checked for valid proof of their affiliation before being granted a pass?	*N/A*	
139	Are vendor personnel and consultants accompanied at all times despite their familiarity to the data centre staff?	*N/A*	
140	Is there a separate room for equipment provided by 3rd parties (e.g. telecommunication equipment / routers) from an ISP to avoid the need to give access to the data centre for such personnel?	*N/A*	
141	Do all racks/cabinets have their own access control mechanism to limit and monitor access to the racks/cabinets?	*N/A*	
	Surveillance and other security measures		
142	Are keys, combination locks, and other security devices installed and used to control access?	*N/A*	
143	Is there a round-the-clock watch patrol going through the facility?	*N/A*	
	Has closed-circuit television (CCTV) been installed to cover:	*N/A*	
145	critical computer equipment?	*N/A*	
146	access routes?	*N/A*	
147	critical storage areas?	*N/A*	

148	critical telecommunications equipment?	*N/A*	
149	Is access to communications equipment (e.g. junction boxes, switches) restricted?	*N/A*	
	Are there restrictions on the introduction into the data centre for:		
151	camera or other photo-recording equipment?	*N/A*	
152	sound magnetic or other recording devices?	*N/A*	
153	Are there electric eyes or motion detectors installed in infrequently-used rooms and passageways?	*N/A*	
154	Are there motion detectors or other intrusion-detecting devices in the false floors and ceilings?	*N/A*	
155	Are all internal doors in the data centre fitted with self-closing mechanisms?	*N/A*	
156	Do all access doors open fully and freely?	*N/A*	
157	Are all doors equipped with sensors to detect and indicate that they are open?	*N/A*	
158	Can all external doors be locked on command from a single security station?	*N/A*	
160	Can all internal doors be locked on command?	*N/A*	
161	If there is a CCTV system, are there personnel assigned to watch the monitors at all times?	*N/A*	
162	Are external walls and windows proof against easy access by a saboteur?	*N/A*	
163	Are all emergency exits wired to sound alarms when opened?	*N/A*	
164	Do emergency exit alarms indicate unambiguously which door has been opened?	*N/A*	
ID	**Security Measure**	**Response**	**Comments**
	House Keeping		
	Is the data centre free of:		
166	accumulations of trash?	*N/A*	
167	surplus or broken furniture?	*N/A*	
168	tapes, canisters, straps or disk covers on top of drives?	*N/A*	
169	printouts, newspapers and magazines?	*N/A*	
170	surplus, disconnected or broken computer equipment?	*N/A*	
171	Are equipment covers and work surfaces cleaned regularly?	*N/A*	
172	Are floors washed regularly?	*N/A*	
173	Is carpeting anti-static?	*N/A*	

174	Are all flammable materials (paper, inks, ribbons, boxes) kept to a minimum in the data centre?	*N/A*	
175	Are food and drink absolutely forbidden in the computer room?	*N/A*	
176	Are CCTV lenses regularly cleaned?	*N/A*	
177	If yes, how often (frequency)?	*N/A*	
178	Are operator and maintenance manuals stored neatly in an assigned place adjacent to (but outside) the computer room)?	*N/A*	
179	Is there a prominent notice announcing AUTHORISED PERSONNEL ONLY — OPERATORS MAY NOT ADMIT VISITORS WITHOUT AUTHORISATION.	*N/A*	

Response: Yes, No, Partial, an "empty" cell (Not applicable) or "N/A" for information is not available

6.8   Facilities Infrastructure – Planned Changes

Project	Timeline	Budget [US$]	Completed [%]
Data Centre & Communication Network (DCCN) – For details refer to Attachment **Error! Reference source not found.**	2019	N/A	5

7. Network Infrastructure

This section describes the network infrastructure, separated into sections for Wide and Local Area Networks, Wireless Networks, Remote Access, Internet Access, TCP/IP setup, and Network controls.

7.1 General Notes

PDS operates a relatively large WAN that provides communications links to remote sites (District / Regional Office, Substation, etc.) and the PDS Data Centres. In addition, PDS operates a separate VHF radio network that provides communications links between the SCADA information system located at the Distribution Network Control Centres whereby the remote terminal units (RTUs) are installed at substations and equipment sites located throughout the PDS distribution network.

The ICT BU is responsible to provide and manage network connectivity up to the PDS firewalls that integrate the SCADA environment. The SCADA Supervisory Systems division in the Operations directorate is responsible to manage the SCADA environment (devices, etc). The responsible contact is the Manager Mr. John Gamega, Tel. 024 422 6009. Access between the two networks (Office and SCADA) is managed by the ICT BU.

No standard configuration guidelines and templates for WAN, LAN, WLAN or any other type of network devices are in use by PDS.

WAN devices (Mikrotik routers/switches) are configured to use SNMP v3. No further information, e.g. the SNMP v3 setup / configuration details, was provided by PDS due to security concerns. LAN devices are configured for SNMP, but the version could not be confirmed and no further information was provided due to security concerns.

No evidence (e.g. configuration dumps of the network devices) for best-practise configuration of WAN, LAN, WLAN and other network devices was provided since the ICT BU rejected to hand over configuration dumps motivated by security reasons.

In most instances the ICT BU did not provide hostnames and IP addresses of the WAN, LAN, WLAN and other network devices due to security concerns.

The ICT BU explained that PDS's WAN devices are not connected to a management network since the Mikrotik devices do not offer such management ports. Also, other LAN devices are not connected to a management network.

WAN devices are managed using Telnet, SSH and Mikrotik "The Dude" software. Switches are accessed and managed using the built-in web interface or Telnet sessions.

7.2   Wide Area Network

7.2.1   Topology / Layout

The Wide Area Network (WAN) topology of PDS, interconnecting the various business locations, is based on leased lines from various Network Service Providers (NSPs), namely MTN Ghana, Vodafone Ghana, GRIDCo, AirtelTigo and PDS itself (refer to section 7.2.1.2 for details), wireless links from NSPs and PDS owned wireless links operating in the unlicensed band (using 5 GHz technology), and fibre optic cabling owned by PDS.

Detailed logical and physical WAN diagrams and accompanying narratives explaining the setup depicted in the diagrams were not provided by PDS. Refer to the diagram that follows for a highlevel overview of the PDS network.

Figure 15: High Level Network Diagram
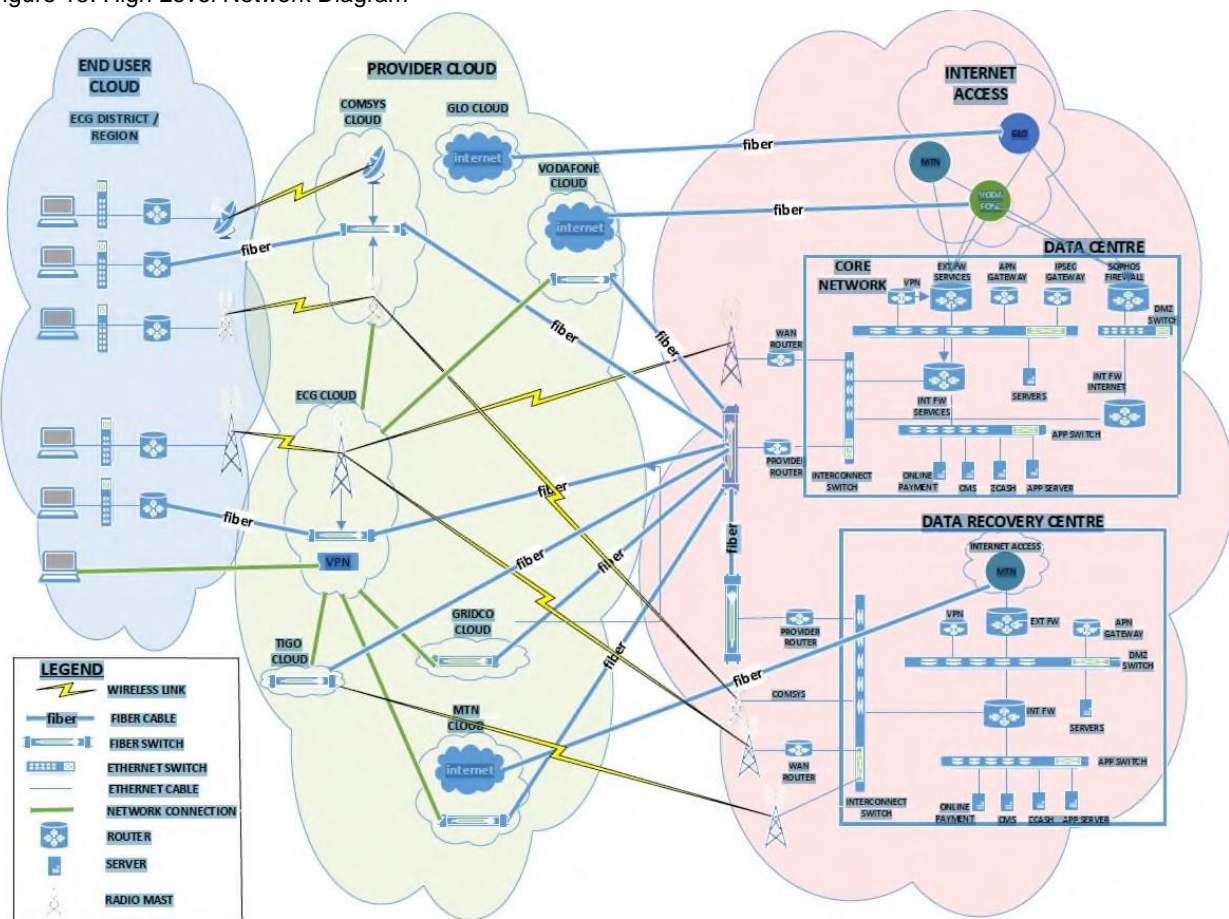
According to the ICT BU, PDS has redundancy in place for all of its WAN links. However, this statement is in contradiction to the WAN links information provided by the ICT BU (refer to Table 67 below).

PDS endeavours to use different NSPs to provide primary and secondary connectivity to a business location. However, this is not always the case as can be derived from Table 67 below.

Furthermore, it is unclear for which WAN links the failover between primary and secondary (backup) link takes place automatically and where manual intervention by the ICT BU is required.

During our site visits personnel at the Regional and District Offices raised that the reliability of the WAN links is a major issue. The ICT BU estimates that the availability level of the connectivity to the remote offices is at about 85%. This value equals to about 55 days downtime in a year which classifies PDS's IT network as unmanaged (below 99.8%)

Furthermore, the ICT BU complains about the service delivery (poor response and resolve times) of the NSPs, but no evidence could be provided that supports such complaints.

The figure below was provided by the ICT BU; it outlines the principal connectivity setup to a remote office of PDS.

Figure 16: High-level Network Design of a Remote Office
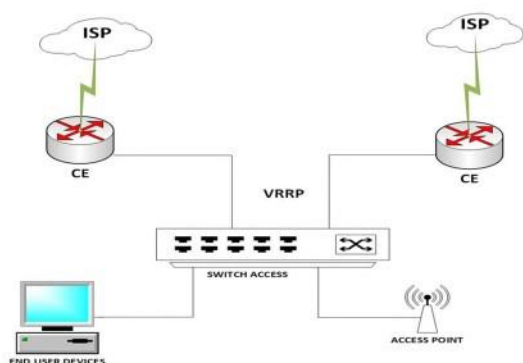
7.2.1.1   WAN Links

The links of the various NSPs terminate on the PDS network using a router gateway being a single point of failure.

No evidence for the utilisation data (e.g. from a monitoring system) listed in below table were provided by the ICT BU.

For some locations *three* NSPs providing connectivity according to the data supplied by the ICT BU (refer to the blue marked locations). Locations marked red do not have redundant connectivity in place. Furthermore, it needs to be noted that not all of PDS's business locations are covered by below data, e.g. the Training School and Cape Coast DO are not listed.

Table 67: WAN Links

From Location	To Location	NSPs	Technologies	Tx/Rx Cap. [Mbps]	Util. [%]
Special Locations					
Substation G	Projects Office	PDS/PDS	Fibre/WL	1k/1k 19/15	NA/NA
Achimota Station H	Projects Office	PDS	WL	1k/1k	NA

Tema Depot	Projects Office	PDS	Fibre	1k/1k	NA

From Location	To Location	NSPs	Technologies	Tx/Rx Cap. [Mbps]	Util. [%]
Heritage Towers	Projects Office	PDS	Fibre	22/19	30
Electro-Volta (HO)	Projects Office	PDS	WL	30/20	30
Accra East Region					
S/E Makola	Projects Office	PDS/PDS	Fibre/WL	1k/1k 19/15	NA/NA
N/E Legon (DR Site)	Projects Office	Tigo/PDS/PDS	WL/Fibre/WL	2/2 1k/1k 6/13	NA/NA/NA
Mampong	Projects Office	PDS	WL	3/6	NA
Roman Ridge	Projects Office	PDS/PDS	Fibre/WL	1k/1k 15/16	NA/NA
Teshie	Projects Office	PDS	WL	4/3	NA
Kwabenya	Projects Office	PDS/PDS	Fibre/WL	1k/1k 7/10	NA/NA
Dodowa	Projects Office	PDS/PDS	Fibre/WL	1k/1k 7/10	NA/NA
Accra West Region					
Regional Office Accra W	Projects Office	PDS/PDS	Fibre/WL	1k/1k 19/19	NA/NA
S/W Korle Bu	Projects Office	PDS	WL	9/3	NA
N/W Achimota	Projects Office	PDS	WL	1/3	NA
Nsawam	Projects Office	PDS/PDS	Fibre/WL	1k/1k 4/4	NA/NA
Bortianor	Projects Office	PDS	WL	5/7	NA
Dansoman	Projects Office	PDS	WL	4/3	NA
Kaneshie	Projects Office	PDS	Fibre	19/19	NA
Tema Region					
Regional Office Tema	Projects Office	GridCo/PDS/PDS	Fibre/Fibre/WL	20/20 1k 17/19	NA/NA/NA
South	Projects Office	GridCo/PDS/PDS	Fibre/Fibre/WL	20/20 1k 16/7	NA/NA/NA
North	Projects Office	GridCo/PDS/PDS	Fibre/Fibre/WL	20/20 1k 8/5	NA/NA/NA
Prampram	Projects Office	GridCo/PDS	Fibre/WL	20/20 12/5	NA/NA
Nungua	Projects Office	GridCo/PDS	Fibre/WL	20/20 9/8	NA/NA
Afienya District	Projects Office	GridCo/PDS/PDS	Fibre/Fibre/WL	20/20 1k 8/5	NA/NA/NA
Ada	Projects Office	MTN/PDS	WL/WL	2/2 10/4	NA/NA
Somanya	Projects Office	MTN/PDS	WL/WL	2/2 3/2	NA/NA
Ashanti Region (West)					
Kumasi S/W	Projects Office	Voda/GridCo	Fibre/Fibre	10/10 20/20	40/60
Kumasi N/W (Suame DO)	Projects Office	Voda/GridCo	Fibre/Fibre	10/10 20/20	40/60
Bekwai	Projects Office	Voda/GridCo	Fibre/Fibre	10/10 20/20	40/60
Offinso	Projects Office	Voda/GridCo/MTN	Fibre/Fibre/WL	10/10 20/20 2/2	40/60/NA
Abuakwa (Denyame)	Projects Office	Voda/GridCo	Fibre/Fibre	10/10 20/20	40/60
Obuasi	Projects Office	GridCo/MTN	Fibre/WL	20/20 2/2	60/NA
Dunkwa	Projects Office	GridCo/MTN	Fibre/WL	20/20 2/2	60/NA

New Adubiase	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Ashanti Region (East)					
Regional Office Kumasi	Projects Office	Voda/GridCo	Fibre/Fibre	10/10 20/20	40/60
Konongo	Projects Office	Voda/GridCo	Fibre/Fibre	2/2 20/20	40/60
Effiduase	Projects Office	Voda/GridCo	Fibre/Fibre	10/10 20/20	40/60
Mampong	Projects Office	Voda/MTN	Fibre/WL	10/10 2/2	40/NA
Kwabre	Projects Office	Voda/GridCo	Fibre/Fibre	10/10 20/20	40/60
Ayigya	Projects Office	Voda/GridCo	Fibre/Fibre	10/10 20/20	40/60
Asokwa	Projects Office	Voda/GridCo	Fibre/Fibre	10/10 20/20	40/60
Manhyia	Projects Office	Voda/GridCo	Fibre/Fibre	10/10 20/20	40/60
Western Region					
Regional Office Takoradi	Projects Office	Voda/GridCo	Fibre/Fibre	4/4 20/20	40/60
Sekondi	Projects Office	Voda/GridCo	Fibre/Fibre	4/4 20/20	40/60

From Location	To Location	NSPs	Technologies	Tx/Rx Cap. [Mbps]	Util. [%]
Bibiani	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Sefwi Wiaso	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Juabeso	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Enchi	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Asankragwa	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Tarkwa	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Axim	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Half Assini	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Bogoso	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Agona Nkwanta	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Central Region					
Regional Office Cape Coast	Projects Office	Voda/GridCo	Fibre/Fibre	4/4 20/20	40/60
Breman Asikuma	Projects Office	Voda/GridCo/Tigo	Fibre/Fibre/WL	4/4 20/20 2/2	40/60/NA
Saltpond	Projects Office	Voda/GridCo	Fibre/Fibre	4/4 20/20	40/60
Ajumako	Projects Office	Voda/GridCo/Tigo	Fibre/Fibre/WL	4/4 20/20 2/2	40/60/NA
Swedru	Projects Office	Voda/GridCo/Tigo	Fibre/Fibre/WL	4/4 20/20 2/2	40/60/NA
Winneba	Projects Office	Voda/GridCo	Fibre/Fibre	4/4 20/20	40/60
Kasoa North	Projects Office	PDS	WL	26/22	100
Kasoa South	Projects Office	PDS	WL	30/28	100
Twifo Praso	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Assin Fosu	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Eastern Region					

Nkawkaw	Projects Office	Voda/GridCo	Fibre/Fibre	4/4 20/20	40/60
Suhum	Projects Office	Voda/GridCo	Fibre/Fibre	4/4 20/20	40/60
Kibi	Projects Office	MTN	WL	2/2	NA
Regional Office Koforidua	Projects Office	Voda/GridCo	Fibre/Fibre	4/4 20/20	40/60
Donkorkrom	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Kade	Projects Office	Tigo	WL	2/2	NA
Asamankese	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Akim Oda	Projects Office	MTN	WL	2/2	NA
New Abriem	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Mpraeso	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Akim Tafo	Projects Office	Voda/GridCo	Fibre/Fibre	4/4 20/20	40/60
Assesewa	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Begoro	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Akwati	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
Volta Region					
Regional Office Ho	Projects Office	Voda	Fibre	4/4	40
Kpando	Projects Office	Voda/Tigo	Fibre/WL	4/4 2/2	40/NA
Hohoe	Projects Office	Voda/MTN/Tigo	Fibre/WL/WL	4/4 2/2 2/2	40/NA/NA
Jasikan	Projects Office	Voda/MTN/Tigo	Fibre/WL/WL	4/4 2/2 2/2	40/NA/NA
Akatsi	Projects Office	Voda/MTN	Fibre/WL	4/4 2/2	40/NA
Keta	Projects Office	Voda/MTN/Tigo	Fibre/WL/WL	4/4 2/2 2/2	40/NA/NA
Denu	Projects Office	Voda/MTN/Tigo	Fibre/WL/WL	4/4 2/2 2/2	40/NA/NA
Kpeve	Projects Office	Voda/MTN/Tigo	Fibre/WL/WL	4/4 2/2 2/2	40/NA/NA
Sogakope	Projects Office	Voda/Tigo	Fibre/WL	4/4 2/2	40/NA
Dambai	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA
From Location	**To Location**	**NSPs**	**Technologies**	**Tx/Rx Cap. [Mbps]**	**Util. [%]**
Nkwanta	Projects Office	MTN/Tigo	WL/WL	2/2 2/2	NA/NA

Voda=Vodafone, WL=Wireless (Radio), Cap.=Capacity (Bandwidth), 1k=1024, Util.=Link Utilisation in Percent, NA=N/A

7.2.1.2 NSP Designs

The ICT BU has provided WAN design diagrams, as supplied by the NSPs, which are depicted in the figures that follow. It is unclear how far these designs are actually implemented at this stage.

It is unknown if the operators are using completely independent infrastructure (backbone) up to and including the last-mile or if some NSPs are sharing their backbone infrastructure. However, it is most likely the case that they are having their own, independent core network infrastructure.

Figure 17: WAN – Vodafone Architecture
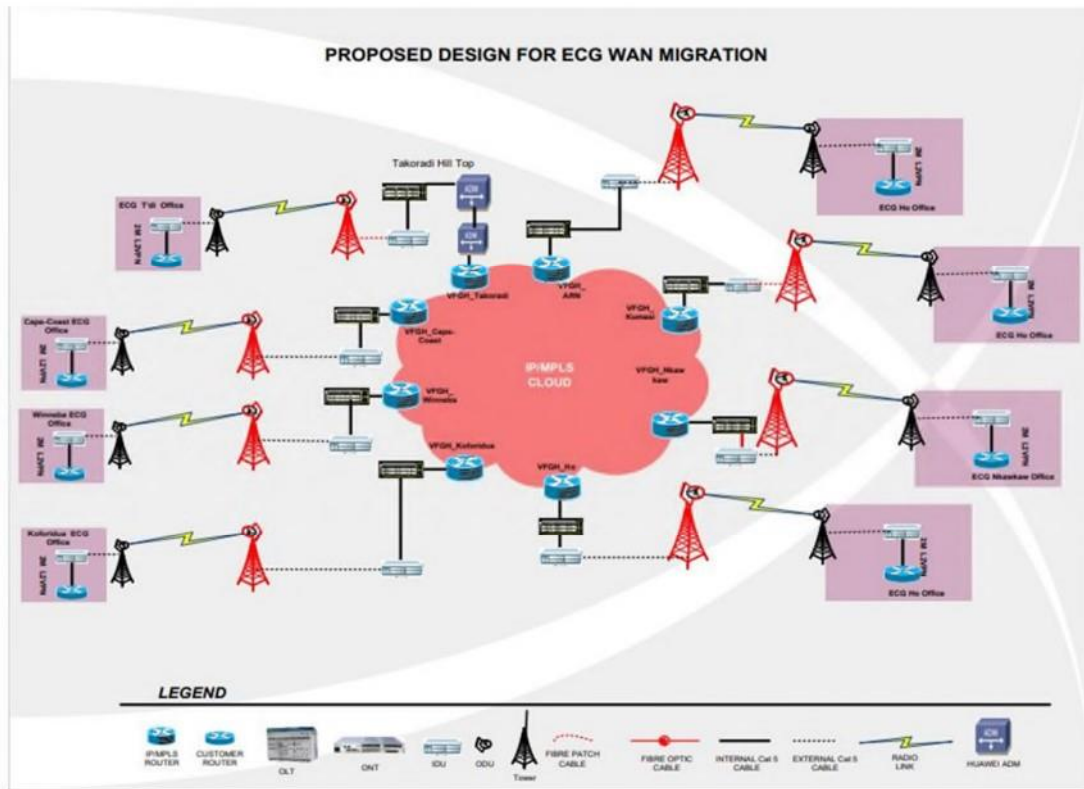
Figure 18: WAN – MTN Architecture
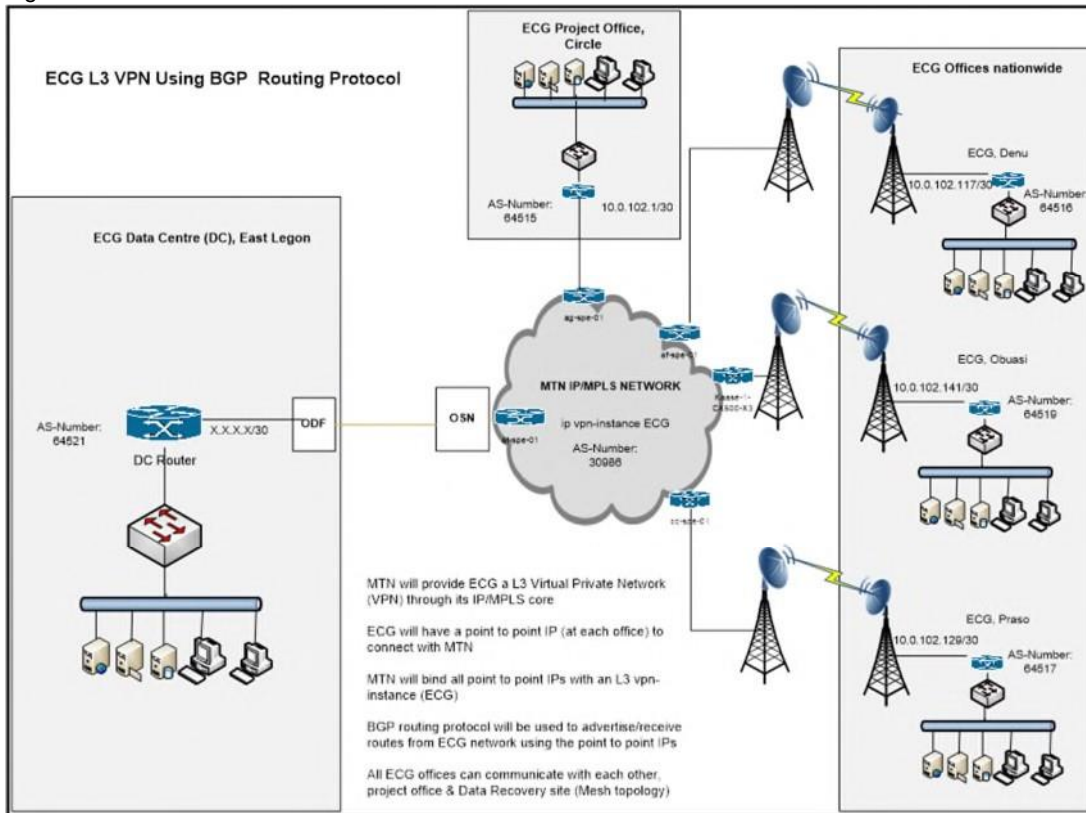
Figure 19: WAN – Tigo Architecture
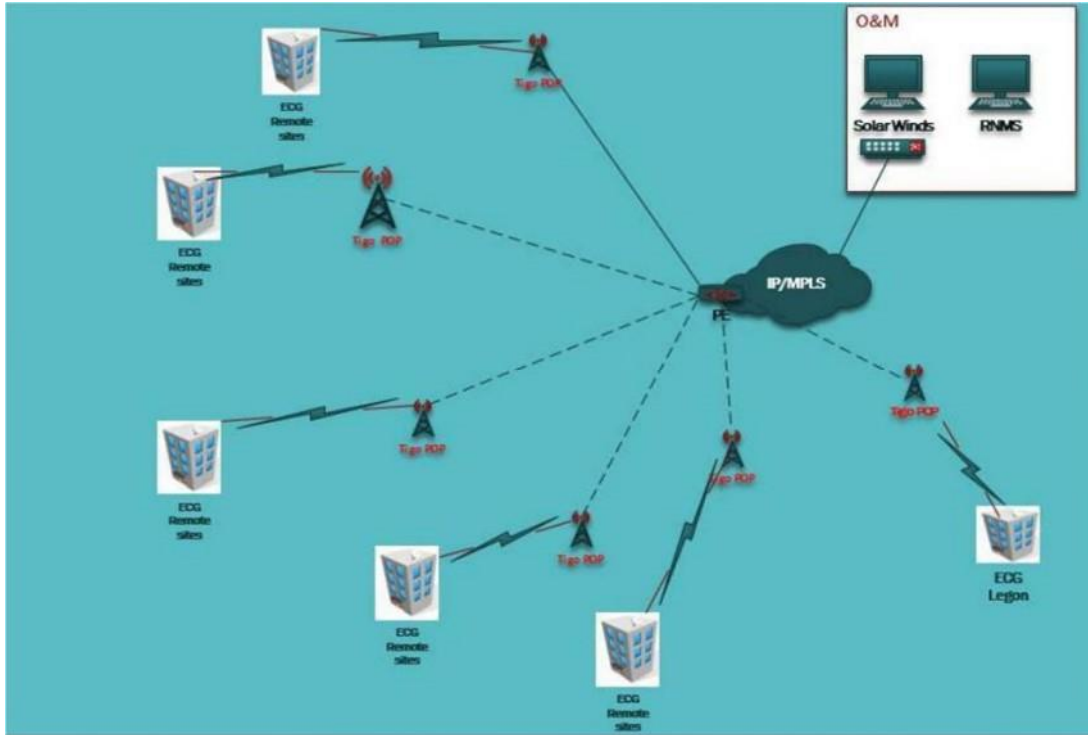
Figure 20: WAN – Glo Architecture N/A

Figure 21: WAN – GridCo Architecture N/A

7.2.1.3   Fibre Optic WAN

PDS is using various fibre links from GRIDCo and Vodafone. Refer to below figure for an overview
of links provided by the tow NSPs.

Figure 22: WAN – Vodafone & GridCo Fibre Optic Network
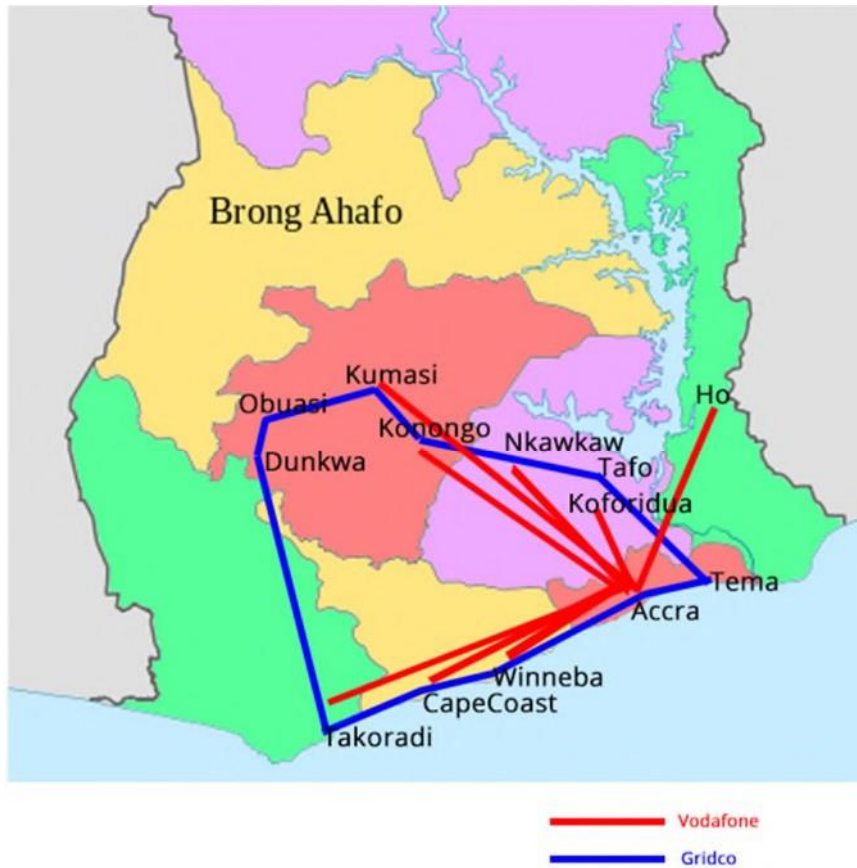
PDS is in the process of adding further fibre links to its existing network. Refer to the figures that follow for an overview of PDS's own fibre network.

Figure 23: WAN – PDS Accra/Tema Fibre Backbone Block Diagram
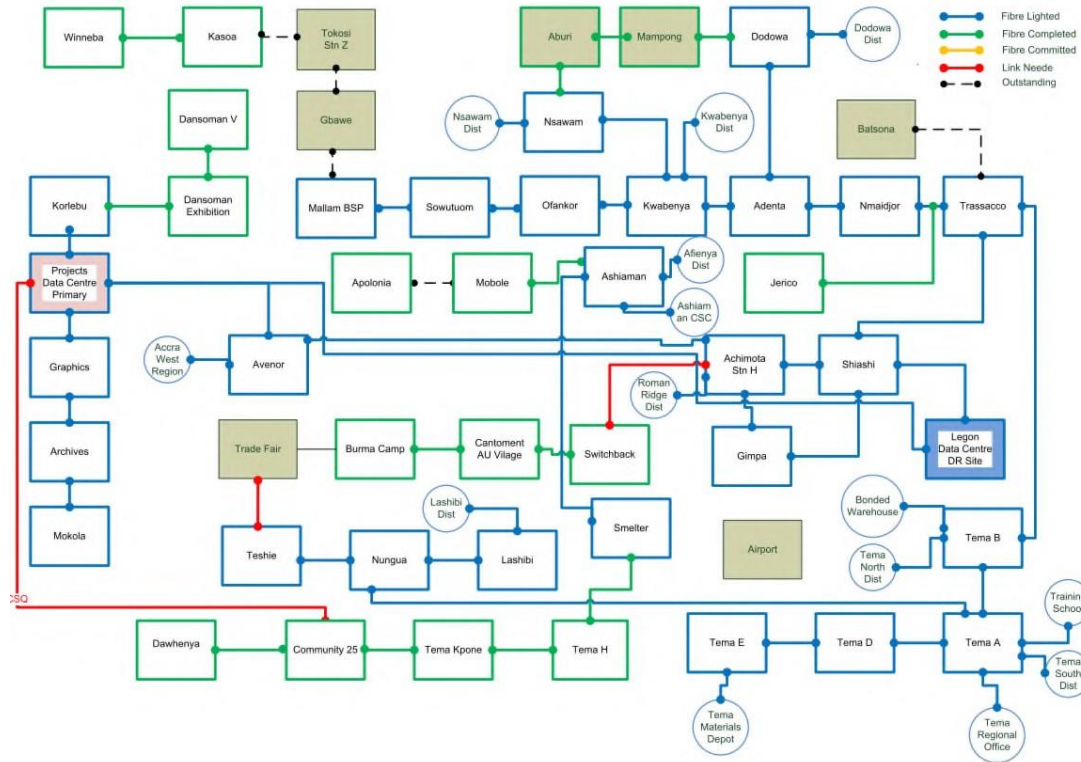
Figure 24: WAN – PDS Ashanti Fibre Backbone Block Diagram
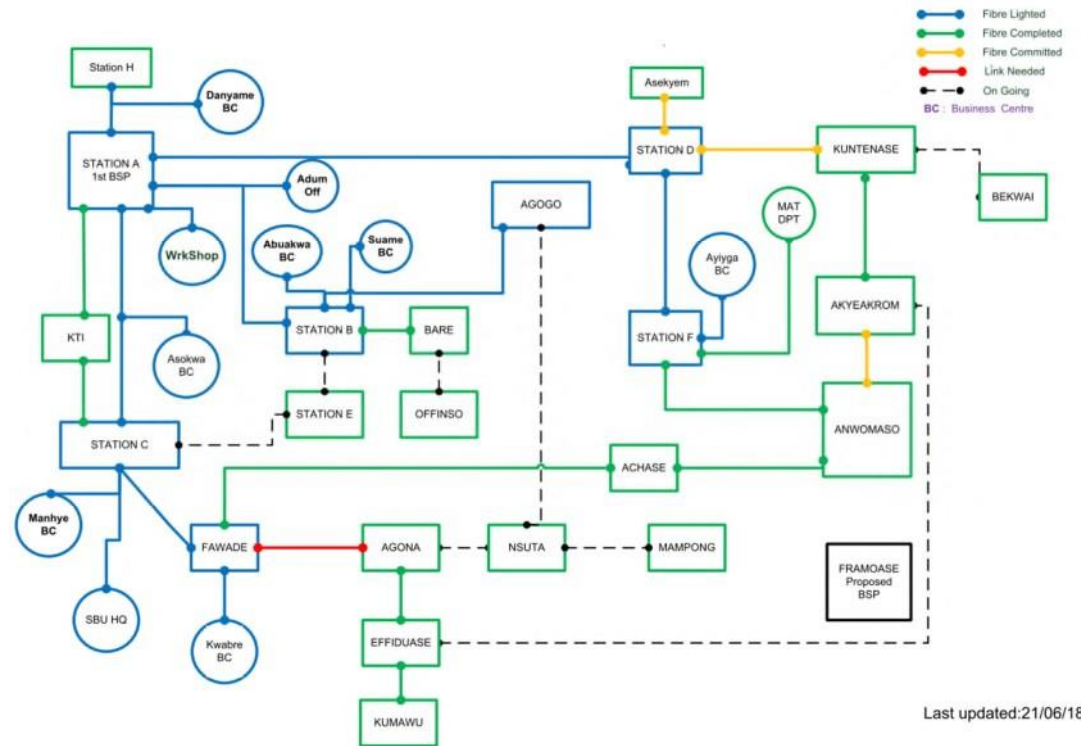
7.2.1.4   Wireless WAN

The ICT BU has neither implemented authentication for its WWAN access points nor MAC address filtering. The traffic over the WAN link is not encrypted.

Figure 25: Wireless WAN – Accra Region
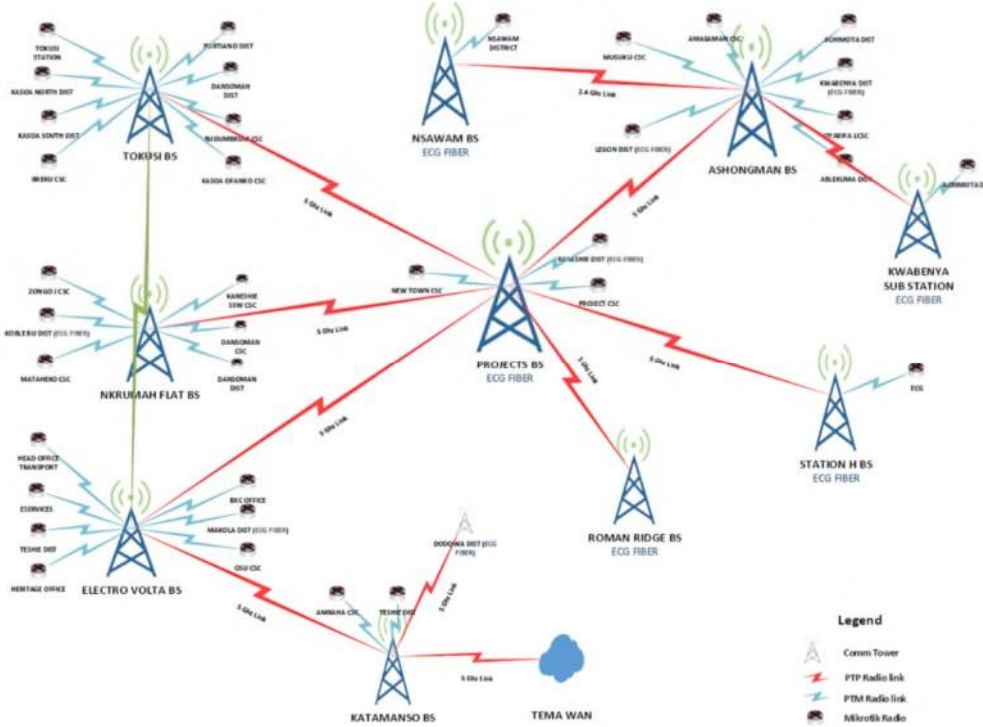
Figure 26: Wireless WAN – Tema Region
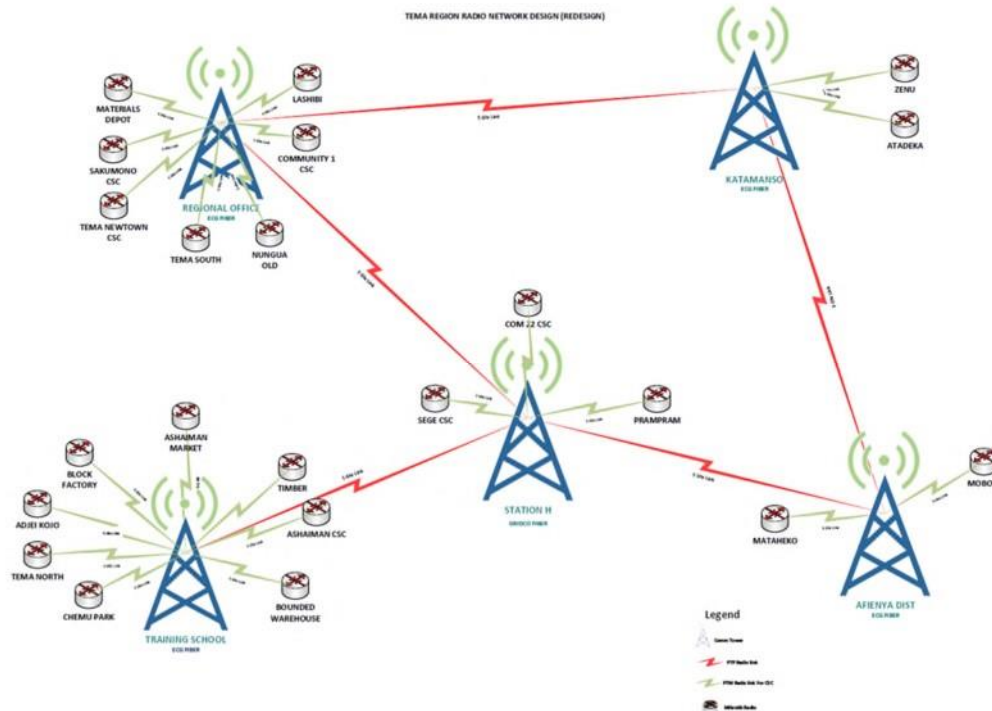
Monitoring views (taken from Mikrotik "The Dude") of the wireless links of the PDS WAN are contained in the Attachments **Error! Reference source not found.** to **Error! Reference source no t found.**, and further technical details about the wireless links can be found in Attachment **Error! Reference source not found.**.

7.2.1.5 SCADA WAN

SCADA WAN is based on VHF radio links. Despite operating in licensed frequency bands, the connectivity is subject to interferences which make the VHF network in certain areas unreliable. The ICT BU, accommodating also the SCADA Radio support team, is in the process of changing the SCADA connectivity from VHF to fibre optic links.

7.2.1.6 Meter WAN

The power meters at the customer premises communicate with the MMS servers via APN/GPRS or a hybrid of ZigBee backbone connections firstly to a concentrator and thereafter via GPRS to the MMS server.

7.2.2 WAN Devices

PDS's network routers are mostly based on Mikrotik products. For a list of WAN devices refer to Attachment **Error! Reference source not found.**.

Table 68: WAN Devices

Asset ID/Tag	Hostname	DNS Alias(es)	Loopback IP	Make Model	SW Rel.	Location
See Attachment **Error! R eference source not found.**						

7.2.3 WAN Reporting

The NSPs indicate that reporting for customers is available. However, no access for PDS has been provided by the NSPs and no statistics are available from the NSPs for any of the WAN links. Also, no statistics regarding availability and utilisation of any of the WAN links were provided by the ICT BU.

7.3 Local Area Network

7.3.1 Topology / Layout

The Local Area Networks (LANs) of PDS are Ethernet topology based employing UTP Category 5, 5e, 6 and 7 (the latter for uplinks only). PDS is in the process of upgrading its offices in all regions to UTP Cat 5e or Cat 6.

Detailed logical diagrams and accompanying narratives explaining the setup depicted in the diagrams for LANs at the various business locations were not provided by PDS. Refer to Figure 15 for a high-level overview of the PDS network.

PDS does not have best-practise, dedicated diagrams depicting the physical components (devices such as switches, routers, Telecom equipment, WAPs, etc.), their ports, and connections between the devices for each location.

Data cabling diagrams that would show which data port on a device connects to which patch panel port or other data port of another device (e.g. Switch SWI100, Port 1 connects to Port 3 on Patch Panel 3 in Rack 1, Server SVR100, Port 2 connects to Switch SWI200, Port 3) could not be provided.

Little further information was provided by the ICT BU which could assist reviewing the LAN situation of PDS. The information outlined in the paragraphs that follow has been derived from the site visits of the Consulting team.

Most buildings/offices have one or more Ethernet switches from various vendors (TrendNet, LinkSys, HP, 3COM) to which all of the network points and devices at that location connect (mostly via Patch Panels). Maps of the various business locations depicting the property and buildings at that location were not made available.

There is merely any form of LAN redundancy in place at the remote business locations. The switches are mostly low-end devices and are mainly from Tier-2 or Tier-3 network vendors. The switches and the power supply of the various devices are single points of failure at a location.

Table 69: LAN Topology

Location	Building / Floor / Section	Topology	Cable Type	Comments
N/A				

7.3.2   LAN Devices

LAN device information was not provided by the ICT BU as listed in below table and in Attachment **Error! Reference source not found.**. Network switches currently used by PDS are sourced from v arious vendors, such as Hewlett-Packard, TrendNet, 3COM, LinkSys and Cisco.

Table 70: LAN Devices – Project Office and Legon DR Site

Asset ID/Tag	Hostname	Type	Loopback IP	Make Model	SW Rel.	Location
N/A	N/A	Router	N/A	Mikrotik CCR1036-12G-4S	6.36.3	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1036-12G-4S	6.36.3	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1036-12G-4S	6.36.3	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1036-12G-4S	6.36.3	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1036-12G-4S	6.36.3	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1036-12G-4S	6.36.3	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1036-12G-4S	6.36.3	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1036-12G-4S	6.36.3	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1036-12G-4S	6.36.3	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1036-8G-2S	6.36.3	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1016-12S-1S+	N/A	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1072-1G-8S	N/A	Project Office

N/A	N/A	Router	N/A	Mikrotik CCR1016-12G	N/A	Project Office
N/A	N/A	Switch	N/A	HP A5830AF-48G 48 Port	N/A	Project Office
N/A	N/A	Switch	N/A	HP A5830AF-48G 48 Port	N/A	Project Office
N/A	N/A	Switch	N/A	HP V1910-24G 24 Port	N/A	Project Office
N/A	N/A	Switch	N/A	HP V1910-24G 24 Port	N/A	Project Office
N/A	N/A	Switch	N/A	HP Procurve 2650 48 Port	N/A	Project Office
N/A	N/A	Switch	N/A	HP Procurve 2650 48 Port	N/A	Project Office
N/A	N/A	Switch	N/A	HP Procurve 2650 48 Port	N/A	Project Office
N/A	N/A	Switch	N/A	HP Procurve 2650 48 Port	N/A	Project Office
N/A	N/A	Switch	N/A	HP Procurve 2650 48 Port	N/A	Project Office
N/A	N/A	Router	N/A	Mikrotik CCR1016-12G	6.36.3	Legon DR
N/A	N/A	Router	N/A	Mikrotik CCR1072-1G-8S+	6.30.2	Legon DR
N/A	N/A	Router	N/A	Mikrotik CCR1072-1G-8S+	6.30.3	Legon DR
N/A	N/A	Router	N/A	Mikrotik CCR1036-12G-4S	6.42.6	Legon DR
N/A	N/A	Router	N/A	HP A5830AF-48G 48 Port	N/A	Legon DR
N/A	N/A	Switch	N/A	HP Procurve 2650 48 Port	N/A	Legon DR
N/A	N/A	Switch	N/A	HP Procurve 2650 48 Port	N/A	Legon DR
N/A	N/A	Switch	N/A	HP Procurve 2650 48 Port	6.36.3	Legon DR

7.3.3   LAN Reporting

No reports regarding availability and utilisation of the LANs were made available.

7.4   Wireless Local Area Network

The ICT BU reported that it implemented WLAN infrastructure only at the Project Office. However, it was also stated that other PDS Business Units connect wireless APs to the PDS LANs without informing and involving the ICT BU. In fact, the ICT BU will not even know when wireless APs are connected to a LAN due to the absence of a Network Access Control (NAC) solution.

WLAN devices are not configured for SNMP.

PDS neither has a Bring-Your-Own-Device (BYOD) policy nor appropriate tools to manage and control wireless access by privately / company owned devices.

7.4.1   Topology / Layout

Detailed logical diagrams and accompanying narratives explaining the setup depicted in the diagrams for WLANs at the various business locations were not provided by PDS. Refer to Figure 15 for a high-level overview of the PDS network.

The ICT BU did not provide a physical WLAN diagram showing, inter alia, the AP locations at the sites where WLANs are deployed.

Management ports of the APs are, according to the ICT BU, connected to a management network.

7.4.2 WLAN Devices

Wireless Controllers and Access Points (WAPs) deployed at PDS are listed in below tables. WLAN device information, apart from the Project Office, were not provided by the ICT BU.

Table 71: Wireless Controllers

Asset ID/Tag	Hostname	IP	Make / Model	SW Rel.	Location
None					

SW Rel. = Software Release of Device

Table 72: Wireless Access Points

Asset ID/Tag	Hostname	IP	SSID	Key	Security	Make / Model	Location
N/A	ACCPRO-BLKB&C_Wifi	N/A	ACCPRO-BLKB&C2G	N/A	WPA2-PSK	RouterBOARD cAP Gi-5acD2nD	Projects Office Block B & C
N/A	ACCPRO-BLKB&C_Wifi	N/A	ACCPRO-BLKB&C5G	N/A	WPA2-PSK	RouterBOARD cAP Gi-5acD2nD	Projects Office Block B & C
N/A	ACCPRO-D2_Wifi	N/A	D2 Conference Room Wifi-2G	N/A	WPA2-PSK	RouterBOARD cAP Gi-5acD2nD	Projects Office Conf. Room D2
N/A	ACCPRO-D2_Wifi	N/A	D2 Conference Room Wifi-5G	N/A	WPA2-PSK	RouterBOARD cAP Gi-5acD2nD	Projects Office Conf. Room D2

7.4.3 WLAN Reporting

No reports regarding availability and utilisation of the WLANs were made available.

7.5 Remote Network Access

PDS has deployed and uses the Mikrotik VPN solution and the MS Windows VPN client to provide remote access to its network.

IP ranges assigned to VPN clients were not provided by the ICT BU due to security concerns. PDS does not use 2-factor authentication for remote access.

7.5.1 Remote User Profiles

Remote Profiles are configured using the Mikrotik VPN solution, but no details were provided except that remote access is provided to vending stations and employees subject to the approval

of the respective line manager. User profiles are configured to limit the users' access to IT resources of PDS.

Table 73: VPN User Accounts

Account	Username	Purpose
N/A		

7.5.2 Security Measures

The VPN user accounts are managed locally by the Mikrotik VPN solution without integration with PDS's Active Directory.

7.6 Internet Access

7.6.1 Topology / Layout

PDS is connected to the Internet as depicted in Table 74 using three different Internet Service Providers (ISPs), namely Vodafone Ghana, MTN Ghana and GLO Ghana. The contracts with the ISPs, of which some have not been finalised, are attached hereto under Annexure **Error! R eference source not found.**.

Table 74: Internet Service Providers

ISP	Capacity [Mbps]	Location	Last Mile	Valued-Added Services
Vodafone Ghana	20	Project Office	Leased Line (Fibre)	None
MTN Ghana	45	Project Office	Leased Line (Fibre)	None
GLO Ghana	155	Project Office	Leased Line (Fibre)	None

The links provided by Vodafone and MTN are primarily used for business-critical services such as the vending applications, PDS's public website and E-Mail. The GLO link is used mainly for end-user access to the Internet (e.g. browsing).

The ICT BU neither has dedicated logical / physical diagrams nor associated narratives that document in detail PDS's Internet Access. Refer to Figure 15 for a high-level overview of the PDS network.

All Internet Access links terminate at the Project Office DC. According to the ICT BU Internet traffic will be piped to the Legon DR site in case there is any disaster.

End-point devices are provided and managed by the ISPs as listed in the table below, being the demarcation point between the ISP and PDS network.

Table 75: ISP Devices

Provider	Asset ID/Tag	Hostname	Loopback IP	Make Model	SW Rel.	Location
Vodafone Ghana				Huawei Quid S3300		Project Office
MTN Ghana				Huawei Smart Ax MA5612		Project Office

7.6.2 ISP Value-Added Services

PDS has not subscribed to any value-added services offered by the ISPs, e.g. Anti-Spam or AntiVirus.

7.6.3 ISP Reporting

The ISPs indicate that reporting for customers is available. However, no access for PDS has been provided by the ISPs and no statistics are available from the ISPs for any of the Internet links.

7.6.4 Internet Access Management

PDS has basic guidelines in place, such as limiting bandwidth for end-users, to regulate access to the Internet, but no formal policy exists.

End-users can connect Internet Access solutions, e.g. a wireless modem, to the PDS network without involving, and approval of the ICT BU. In fact, the ICT BU will not even know when this takes place.

7.7 TCP/IP Setup

7.7.1 IP Address Management

PDS has no documented standard for IP Address Management (IPAM) and there is no IPAM tool in use to manage IP addresses. An Excel spreadsheet, used by the Network & Security Division of the ICT BU, documents some aspects of PDS's IP address allocation. However, it could not be verified whether the spreadsheet is comprehensive and aligned to best-practises since it was not made available by the ICT BU.

According to the ICT BU the PDS network is IP based using static addresses for all network and server devices. PDSH uses at its business locations the IP ranges:

- 10.17.100.0/24;
- 10.17.101.0/24;
- 10.170.0.0/24;
- 192.168.x.0/24 for Regional Offices;
- 192.168.y.0/28 for District Offices and Customer Service Centres.

For WAN routers the principles that follow are applied:

- WAN interfaces:

o PTP links: Class A addresses from the ranges 10.0.x.x/30;

o PTMP links: Class A addresses from the ranges 10.0.x.x/28;

▪ Ethernet interfaces:

o Class B addresses from the ranges 172.16.x.x/28

7.7.2   VLAN Setup

PDS has not implemented VLAN segmentation for its network.

7.7.3   DHCP Setup

The following principles are applied for DHCP scopes as indicated below. IP addresses for DHCP Scope start, end and address range exclusions were not provided by the ICT BU due to security concerns.

▪ Regional Offices:

o Class C 192.168.x.x/24

o Reservations: 1st twenty (20) IPs and the last ten (10) IPs of the subnet o

DHCP server hosted on Windows Server 2008 R2

▪ District Offices and Customer Service Centre (CSC) o Class C

192.168.x.x/26 and reservation - 1st ten (10) IPs of the subnet o DHCP

server hosted on the local router

No details of the DHCP Server and Scope options configuration were provided by the ICT BU.

Table 76: DHCP Servers & Scopes

Hostname	Vendor OS Version	Scope Name	Start	End	Exclusions	Location
See Attachment **Error! Reference s ource not found.**						

Table 77: DHCP Server / Scope Options

Hostname	Server or Scope	Server/Scope Option	Value
N/A			

7.7.4 Domain Name Service Setup

7.7.4.1 Domains

Table 78: Internal Domains

Domain	Information	Description
PDSgh.com	N/A	Main Active Directory domain of PDS
PDSgh.net	N/A	Used by AD of InCMS solution

Table 79: Public Domains

Domain	Information	Description
PDSgh.com	IP Address Registrar Hosted by Name Server(s) Expiration Date	N/A Network Solutions, LLC ns23.worldnic.com ns24.worldnic.com 22 April 2020
PDSgh.net	IP Address Registrar Hosted by Name Server(s) Expiration Date	N/A Network Solutions, LLC ns29.worldnic.com ns30.worldnic.com 22 April 2020
PDSgh.org	IP Address Registrar Hosted by Name Server(s) Expiration Date	N/A Network Solutions, LLC ns29.worldnic.com ns30.worldnic.com 15 April 2020
Domain	**Information**	**Description**
PDSonline.info	IP Address Registrar Hosted by Name Server(s) Expiration Date	N/A Network Solutions, LLC ns45.worldnic.com ns46.worldnic.com 22 April 2020

Reverse zones have been configured for all subnets.

7.7.4.2 DNS Servers

Table 80: Internal DNS Server

Hostname	FQDN	IP Address(es)	Replica Servers	Zone(s)	Comment
PROPPVWDC03	N/A	N/A	N/A	N/A	N/A
PROPPVWDC02	N/A	N/A	N/A	N/A	N/A
ELVPPPWDC01	N/A	N/A	N/A	N/A	N/A
ACEPPPWDC01	N/A	N/A	N/A	N/A	N/A
ACWPPPWDC01	N/A	N/A	N/A	N/A	N/A
TMAPPPWDC01	N/A	N/A	N/A	N/A	N/A
ASWPPPWDC01	N/A	N/A	N/A	N/A	N/A
ASEPPPWDC01	N/A	N/A	N/A	N/A	N/A
CENPPPWDC01	N/A	N/A	N/A	N/A	N/A

| ESTPPPWDC01 | N/A | N/A | N/A | N/A | N/A |
| WSTPPPWDC01 | N/A | N/A | N/A | N/A | N/A |

PDS does not operate its own DNS servers to host public DNS records.

Table 81: External DNS Server

Hostname	FQDN	IP Address(es)	Replica Servers	Zone(s)	Comment
None					

7.7.4.3   DNS Records

With the exception of "www", "mail" and "slt" none of the below records leads to a publicly accessible service (website, mail, application, etc.).

Table 82: DNS Records

Domain	Record	IP Address	Comment
PDSgh.com	www	N/A	External Website on server "propppwmx05"
	mail	N/A	MX Record
	secure	N/A	Certificate Services
	pro-cassvr	N/A	Front-End Mail services
	taawescen	N/A	TAA Project
	taareports	N/A	TAA Project
	taaeasvoltem	N/A	TAA Project
	PDS-gis	N/A	GIS Pilot project
Domain	**Record**	**IP Address**	**Comment**
	fservices	N/A	
	taa	N/A	TAA Project
	taaaeaw	N/A	TAA Project
	taabkp	N/A	TAA Project
PDSgh.net	www	N/A	External Website
	mail	N/A	MX Record
PDSgh.org	www	N/A	External Website
	mail	N/A	MX Record
PDSonline.info	www	N/A	External Website
	mail	N/A	MX Record
	moep	N/A	Ministry of Power project

	pos	N/A	POS Project
	slt	N/A	External Website SLT Customers
N/A	N/A	N/A	N/A
N/A	N/A	N/A	Used locally for InCMS Citrix Farm

7.7.4.4   Other Name Resolutions

NMBF does not use NetBIOS or WINS name resolution.

HOSTS or LMHOSTS name resolution is used in some instances, typically determined by the applications of PDS. No details were provided by the ICT BU which servers / workstations use HOSTS / LMHOSTS and how it has been configured.

7.8   Controls

The review included is intended to whether PDS has identified and addressed configuration issues and security threats to its network devices.

The answers in below tables were provided by the ICT BU, but could not be validated against the actual status quo. An "empty" response stands for "Not applicable", and when no answer / information was provided, worst-case scenario is assumed.

Out of 84 controls, PDS does not comply or complies only partially with 57 controls resulting in a compliance ratio of 0%.

Legend:	Compliant or Not Applicable	Partially Compliant	Not Compliant

Table 83: Network Controls Questionnaire

ID	Control	Response	Comments
	Hostname, Gateways, OS and IPs		
1	Are hostnames defined for routers and switches (devices)?	*Partial*	*All routers have hostnames defined but not for all switches*

ID	Control	Response	Comments
2	Are the hostnames added / updated in the internal domain zone?	*No*	*Not for Network devices*
3	Are loopback IPs defined for the devices (where possible)?	*No*	
4	Are the hostnames of the devices linked to the loopback IPs (where applicable)?	*No*	
5	Are the device OS versions up-to-date?	*Partial*	*All WAN routers are updated to the latest stable firmware but not for switches*
6	How often are the device OS updated (frequency)?	*Quarterly*	*Depending on the stable firmware released*

7	Is there a dedicated "Management Network" to which the management ports of the devices are connected to?	*Partial*	*Not all devices are on the management network*
8	Is the Management Network a physically separate network?	*No*	*Logical*
9	If No, Is the Management Network a dedicated VLAN?	Yes	
10	Is the domain name of the local domain configured for the devices?	*No*	
11	Is the default gateway configured for the devices	*Partial*	*Default gateways are configured on the routers*
12	Are all devices and their IP configuration reflected and up-todate in the IPAM?	Yes	
	Authentication		
13	Are the devices using Username/Password authentication (aaa new model)?	*No*	*Authentication is done on the local devices.*
14	Are the devices using secret, encrypted passwords?	Yes	
15	Are the devices using a local database for authentication?	*Yes*	*Database is on the local devices*
16	Has a login banner been defined informing the user about ownership and restrictions of using the device?	*No*	
17	Has the minimum password length been defined (>= 8 characters)?	*No*	
	Logging		
18	Is logging enabled?	Yes	
19	If yes, are logs sent to a Syslog server?	*No*	*Syslog server is still being configured*
20	If yes, has logging been configured for Telnet, SSH and other ports?	*N/A*	
21	Has logging been disabled for the console?	*N/A*	
	VLANs		
22	Are VLANs in use?	Yes	
23	If yes, are permissions defined for all VLANs?	*No*	*Permissions are defined on just core switches*
24	Has the default VLAN changed from 1 to another VLAN?	Yes	*No port is allocated to default VLAN*
	Time Setup		
25	Has a local NTP server been setup?	Yes	
26	If yes, provide hostname(s) of local NTP servers		*PROMPPPRT07 / PROMPPPRT03* *There is a primary server and a secondary server*
27	Have all devices been configured to use the local or an external (e.g. pool.ntp.org) time servers?	Yes	
28	Have all devices been configured to use encrypted NTP authentication?	*No*	
29	Have all devices been configured with the Ghana time zone?	*No*	

	SNMP		
30	Has SNMP been configured for the devices? Provide community names and	*Yes*	
31	If yes, has version v2c and/or v3 been configured?	*Yes*	*v3*

ID	Control	Response	Comments
32	Are the community names complex (e.g. mixed alphanumeric, special characters)?	*No*	
33	Have the interface indexes been set top fixed for all devices?	*No*	
34	Has the SNMP contact been defined for all devices?	*No*	
35	Has the SNMP location been defined for all devices?	*No*	
36	Has the SNMP chassis been defined for all devices?	*No*	
37	Has SNMP read-write access been disabled?	*No*	
38	Have limited SNMP servers been defined (that can access the devices)?	*Yes*	
39	Have SNMP traps been configured?	*No*	
	Services		
40	Is the "password encryption" service enabled?	*Yes*	
41	Is the "timestamps" service configured?	*Yes*	
42	Is the "sequence-numbers" service configured?	*No*	
43	Are TCP and UDP small services disabled?	*Yes*	
44	Are IN and OUT "tcp-keepalives" services configured?	*No*	
45	Is the "NAGLE" service enabled?	*N/A*	
46	Is the "PAD" service disabled?	*No*	
47	Is the domain lookup (DNS) service disabled?	*Yes*	*For all our core routers*
48	Is the "TFTP" service disabled?	*Yes*	*For all our core routers*
49	Is the "BOOTP" service disabled?	*Yes*	*For all our core routers*
50	Is the "DHCP" service disabled?	*Partially*	*DHCP is disabled on our core routers but some routers are used as DHCP servers for some of our offices*
51	Is the "TELNET" service disabled?	*Yes*	*For all our core routers*
52	Is the "CDP" service disabled?	*Yes*	*For all our core routers*
53	Is the "FINGER" service disabled?	*N/A*	
54	Are the "HTTP/HTTPS" services disabled?	*Partial*	*For all our core routers*

	Tweaks		
55	Are the DHCP bindings flashed?	*N/A*	
56	Has the TCP synctime been configured?	*N/A*	
57	Have the name server(s) been configured?	*N/A*	
58	Has a timeout been configured for SSH?	*Yes*	
	For Routers:		
59	Has routing, cef, subnet-zero and classless been configured?	*N/A*	
60	Has source route information been configured?	*N/A*	
	Interfaces		
61	Has the loopback interface for telnet, ftp, tftp, ssh, snmp-server tacacs, radius, ip and ntp been configured?	*No*	
62	Has logging for the loopback interface been enabled?	*No*	
63	Have interface descriptions for all interfaces been defined?	*Yes*	
64	Are unused ports disabled (shut down)?	*Some*	*Not all unused ports are disabled*
65	Has switch port security with MAC learning been enabled?	*No*	
66	If yes, has automatic port shutdown and alerting been configured?	*N/A*	
67	Has switch port trunking been disabled where applicable?	*No*	
	Device Management & Security		
68	Have the authentication retries been limited?	*Yes*	*After three unsuccessful tries, it drops you*
69	Has the SSH version been set to v2?	*N/A*	
ID	**Control**	**Response**	**Comments**
70	Has a RSA key been generated?	*N/A*	
71	Has the "config" service been disabled?	*N/A*	
	For Routers:		
72	Has "lldp" been disabled?	*N/A*	
73	Has "mop" been disabled?	*N/A*	
	Other		
74	Has "IP Directed Broadcast" been disabled?	*N/A*	

75	Has response to ICP mask requests been disabled?	N/A	
	For Routers		
76	Have the OSPF LSA messages accepted by the device been limited?	No	
77	Has configuration auto-loading been disabled?	N/A	
78	Have the AUX ports been disabled?	N/A	
	Access Control		
79	Have Access Control lists been defined for SNMP and VLANs?	Yes	*Specific networks are only given access*
80	Has Administrator access been limited to certain hosts only?	No	*Admins have access to all*
81	Is the device management only accessible from certain networks?	Yes	
82	Has outbound administrator access been disabled?	N/A	*Not Clear*
83	Have all terminal ports been configured?	N/A	
84	Has a console timeout been configured?	N/A	

Response: Yes, No, Partial, an "empty" cell (Not applicable) or "N/A" for information is not available

7.9   Network Infrastructure – Planned Changes

Table 84: Network Infrastructure – Planned Changes

Project	Timeline	Budget [US$]	Completed [%]
Deployment of 2 Mbps Backup WAN links to 35 Remote District Offices	N/A	N/A	N/A
Installation of Accra Metro fibre (close loop)	N/A	N/A	60
Complete Ashanti SBU fibre (Phase 1)	N/A	N/A	60
Commission LAN at twenty offices	N/A	N/A	60
Upgrade three VHF repeater stations	N/A	N/A	60
Extend WAN to twenty offices (CSC, SCADA Control centres)	N/A	N/A	60
Integrate SCADA communication with corporate WAN	N/A	N/A	60
Data Centre & Communication Network (DCCN) – For details refer to Attachment **Error! Reference source not found.**	2019	N/A	5

8. Virtualisation, Server and Storage Environment

This section covers PDS's server environment and provides details regarding virtualisation, Windows- and UNIX/Linux-based servers and services, as well as the storage infrastructure.

8.1 Overview

PDS has two Data Centres in Accra interconnected via a fibre optic and two wireless WAN links. According to the information provided by the ICT BU the Project Office DC has:

- 79 physical servers;
- Two Citrix XenServer hosts;
- 25 stand-alone Microsoft Hyper-V hosts; and ▪ Eight stand-alone VMware ESXi hosts.

The DC at the Legon DR site has:

- Six physical servers;
- One Citrix XenServer host; and
- One standalone Microsoft Hyper-V host.

Additionally, 43 physical servers are located at the Regional and District Offices, and one server at the Head Office, of which some are based on desktop hardware.

A total of 174 Virtual Machines (173 servers, 1 workstation) are operated by PDS distributed over the hosts at the PO DC and the Legon DR site.

The ICT BU did neither provide logical or physical diagrams nor any associated narratives of PDS's server / storage infrastructure.

8.2 Server Hardware

A total of 129 physical servers (three inactive) were reported which are hosted at the Project Office and the Legon DR site. Some details of the servers listed below and information about the servers located in the Regional and District Offices were not provided by the ICT BU.

The procurement date of the servers was not made available, but it can safely be assumed, based on the models given, that a substantial number of servers are beyond end of life.

PDS has configured the IPMI interfaces (iLO, iDRAC, etc) as remote server interface for the physical servers, and connected the IPMI ports to the network.

IP addresses and in many cases also the hostnames of physical servers or VMs were not made available by the ICT BU due to security concerns.

Table 85: Server Hardware

Asset Tag	Manufacturer / Model	Year	CPU	RAM [GB]	Disks – RAID	IPMI IP	Location
1919/SVR/0001	Dell PowerEdge R630	N/A	Intel E5-2690 2.6GHz	192	RAID 1 – 1.5 TB RAID 5 – 3 TB	N/A	PO DC
1919/SVR/0002	Dell PowerEdge R630	N/A	Intel E5-2690 2.6GHz	192	RAID 1 – 1.5 TB RAID 5 – 3.2 TB RAID 5 – 2 TB	N/A	PO DC
1919/SVR/0003	Dell PowerEdge R630	N/A	Intel E5-2690 2.6GHz	192	RAID 1 – 1.09 TB RAID 5 – 5.46 TB	N/A	PO DC
1919/SVR/0004	Dell PowerEdge R630	N/A	Intel E5-2690 2.6GHz	192	RAID 1 – 1 TB RAID 5 – 4.5 TB	N/A	PO DC
1919/SVR/0005	Dell PowerEdge R320	N/A	Intel E5247v2 2.4GHz	8	RAID1 – 1 TB	N/A	PO DC
1919/SVR/0006	Dell PowerEdge R320	N/A	Intel E5-247v2 2.4GHz	8	RAID1 – 1 TB	N/A	PO DC
1919/SVR/0007	HP Proliant DL380 G9	N/A	Intel E5-2620v4 2.1 GHz	32	RAID 5 – 1.09 TB	N/A	PO DC
1919/SVR/0008	HP Proliant DL380 G9	N/A	Intel E5-2620v4 2.1 GHz	16	RAID5 – 1.08 TB	N/A	PO DC
1919/SVR/0009	Dell PowerEdge R720	N/A	Intel E5-2690 2.90GHz	131	RAID 1 – 0.5 TB RAID 5 – 1.8 TB	N/A	PO DC
1919/SVR/0010	Dell PowerEdge R720	N/A	Intel E5-2609 2.40GHz	24	RAID 5 – 1.86TB	N/A	PO DC
1919/SVR/0011	Dell PowerEdge R720	N/A	N/A	N/A	N/A	N/A	PO DC
1919/SVR/0012	Dell PowerEdge R720	N/A	N/A	N/A	N/A	N/A	PO DC
1919/SVR/0013	Dell PowerEdge R720	N/A	Intel E5-2690 2.90GHz	131	RAID 1 – 0.5 TB RAID 5 – 1.8 TB	N/A	PO DC
1919/SVR/0014	Dell PowerEdge R720	N/A	N/A	N/A		N/A	PO DC
1919/SVR/0015	Dell PowerEdge R720	N/A	Intel E5-2690 2.90GHz	86	RAID 1 – 1.8 TB RAID 5 – 1.09 TB	N/A	PO DC
1919/SVR/0016	Dell PowerEdge R710	N/A	N/A	N/A	N/A	N/A	PO DC
1919/SVR/0017	Dell PowerEdge R720	N/Ar	Intel E5-2690 2.90GHz	128	RAID 5 – 1.64 TB	N/A	PO DC
1919/SVR/0018	HP Proliant DL185 G5	N/A	AMD 2354 2.2GHz	2	N/A	N/A	PO DC
1919/SVR/0019	Dell PowerEdge 2950	N/A	Intel E5335 2.0GHZ	16	RAID 5 – 1TB	N/A	PO DC
1919/SVR/0020	Dell PowerEdge 2950	N/A	Intel E5410 2.33 GHZ	16	RAID 5 – 338 GB	N/A	PO DC
1919/SVR/0021	Dell PowerEdge 2950	N/A	Intel E5410 2.33GHz	16	RAID 5 – 271 GB	N/A	PO DC
1919/SVR/0022	HP Proliant DL380 G5	N/A	N/A	N/A	N/A	N/A	PO DC
1919/SVR/0023	HP Proliant DL360 G7	Off	N/A	N/A	N/A	N/A	PO DC
1919/SVR/0024	Dell PowerEdge 1950	Off	N/A	N/A	N/A	N/A	PO DC
1919/SVR/0025	HP Proliant DL380 G5	N/A	Intel E5335 2GHz	16	RAID 1 – 136 GB	N/A	PO DC

| 1919/SVR/0026 | Dell PowerEdge R730xd | N/A | Intel E5-2690v3 2.60GHz | 128 | N/A | N/A | Legon DR |

Asset Tag	Manufacturer / Model	Year	CPU	RAM [GB]	Disks – RAID	IPMI IP	Location
1919/SVR/0027	Dell PowerEdge R730xd	N/A	Intel E5-2690v3 2.60GHz	128	RAID 1 – 0.5 TB RAID 5 – 3.3 TB	N/A	Legon DR
1919/SVR/0028	Dell PowerEdge R730xd	N/A	Intel E5-2690v3 2.60GHz	128	RAID 1 – 0.5 TB RAID 5 – 2.7 TB RAID 5 – 3.3 TB	N/A	PO DC
1919/SVR/0029	Dell PowerEdge R730xd	N/A	Intel E5-2690v3 2.60GHz	128	RAID 1 – 1.1 TB RAID 5 – 4.6 TB	N/A	PO DC
1919/SVR/0030	Dell PowerEdge R730xd	N/A	Intel E5-2690v3 2.60GHz	128	RAID5 – 3.27 TB RAID5 – 2.73 TB	N/A	PO DC
1919/SVR/0031	Dell PowerEdge R730xd	N/A	Intel E5-2690v3 2.60GHz	128	RAID 1 – 0.6 TB RAID 5 – 1 TB RAID 5 – 2 TB	N/A	PO DC
1919/SVR/0032	Dell PowerEdge R730xd	N/A	Intel E5-2690v3 2.60GHz	192	RAID 1 – 1 TB RAID 5 – 1 TB RAID 5 – 2.2 TB	N/A	PO DC
1919/SVR/0033	Dell PowerEdge R730xd	N/A	Intel E5-2690v3 2.60GHz	192	RAID 5 – 1.9 TB RAID 5 – 2.2 TB	N/A	PO DC
1919/SVR/0034	Dell PowerEdge R730xd	Off	Intel E5-2690v3 2.60GHz	128	N/A	N/A	PO DC
1919/SVR/0035	Dell PowerEdge R730xd	N/A	Intel E5-2690v3 2.60GHz	128	N/A	N/A	PO DC
1919/SVR/0036	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID1 – 550 GB	N/A	PO DC
1919/SVR/0037	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID1 – 550 GB	N/A	PO DC
1919/SVR/0038	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID1 – 570 GB	N/A	PO DC
1919/SVR/0039	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID1 – 560 GB	N/A	PO DC
1919/SVR/0040	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID5 – 1.45 TB	N/A	PO DC
1919/SVR/0041	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID1 – 550 GB	N/A	PO DC
1919/SVR/0042	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID1 – 550 GB	N/A	PO DC
1919/SVR/0043	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID1 – 550 GB	N/A	PO DC
1919/SVR/0044	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID1 – 550 GB	N/A	PO DC
1919/SVR/0045	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID1 – 550 GB	N/A	PO DC
1919/SVR/0046	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID1 – 550 GB	N/A	PO DC
1919/SVR/0047	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID1 – 550 GB	N/A	PO DC

1919/SVR/0048	Dell PowerEdge R630	N/A	Intel E5-2690v3 2.60GHz	65	RAID5 – 1.45 TB	N/A	PO DC
1919/SVR/0049	HP Proliant DL360P G8	N/A	Intel E5-2690v2 @ 3GHz	384	RAID1 – 300 GB	N/A	PO DC
1919/SVR/0050	HP Proliant DL360P G8	N/A	Intel E5-2690v2 @ 3GHz	384	RAID1 – 300 GB	N/A	PO DC
1919/SVR/0051	HP Proliant DL360P G8	N/A	Intel E5-2690v2 @ 3GHz	256	RAID1 – 300 GB	N/A	PO DC
1919/SVR/0052	HP Proliant DL360P G8	N/A	Intel E5-2690v2 @ 3GHz	256	RAID1 – 300 GB	N/A	PO DC

Asset Tag	Manufacturer / Model	Year	CPU	RAM [GB]	Disks – RAID	IPMI IP	Location
1919/SVR/0053	HP Proliant DL360P G8	N/A	Intel E5-2690v2 @ 3GHz	256	RAID1 – 300 GB	N/A	PO DC
1919/SVR/0054	HP Proliant DL360P G8	N/A	Intel E5-2690v2 @ 3GHz	64	RAID1 – 300 GB	N/A	PO DC
1919/SVR/0055	HP Proliant DL360P G8	N/A	Intel E5-2690v2 @ 3GHz	64	RAID1 – 300 GB	N/A	Legon DR
1919/SVR/0056	HP Proliant DL360P G8	N/A	Intel E5-2690v2 @ 3GHz	384	RAID1 – 300 GB	N/A	Legon DR
1919/SVR/0057	HP Proliant DL360P G9	N/A	Intel E5-2690v2 @ 3GHz	189	RAID1 – 300 GB	N/A	Legon DR
1919/SVR/0058	HP Proliant DL360P G9	N/A	Intel E5-2690v2 @ 3GHz	189	RAID1 – 300 GB	N/A	PO DC
1919/SVR/0059	IBM Power 710	N/A	PowerPC 710	8	N/A	N/A	PO DC
1919/SVR/0060	IBM Power 710	N/A	PowerPC 710	30	N/A	N/A	PO DC
1919/SVR/0061	IBM Power 710	N/A	PowerPC 710	8	N/A	N/A	N/A
1919/SVR/0062	IBM System X3650	N/A	N/A	N/A	N/A	N/A	PO DC
1919/SVR/0063	IBM System X3650	N/A	N/A	N/A	N/A	N/A	PO DC
1919/SVR/0064	IBM System X3650	N/A	N/A	N/A	N/A	N/A	N/A
1919/SVR/0065	IBM System X3650	N/A	N/A	N/A	N/A	N/A	N/A
1919/SVR/0066	IBM System X3650	N/A	N/A	N/A	N/A	N/A	PO DC
1919/SVR/0067	Dell PowerEdge R640	N/A	Intel 6126 2.60GHz	192	RAID 1 – 1.8 TB RAID 5 – 10.9 TB	N/A	Legon DR
1919/SVR/0068	Dell PowerEdge R640	N/A	Intel 6126 2.60GHz	176	RAID 1 – 1.8 TB RAID 5 – 10.9 TB	N/A	PO DC
1919/SVR/0069	Dell PowerEdge R640	N/A	Intel 6126 2.60GHz	192	RAID 1 – 370 GB RAID 5 – 10.9 TB	N/A	PO DC
1919/SVR/0070	Dell PowerEdge R640	N/A	Intel 6126 2.60GHz	192	RAID 5 – 4.4 TB RAID 5 – 4.4 TB	N/A	PO DC
1919/SVR/0071	Dell PowerEdge R640	N/A	Intel 6126 2.60GHz	192	RAID 1 – 370 GB RAID 5 – 10.9 TB	N/A	PO DC
1919/SVR/0072	Dell PowerEdge R640	N/A	Intel E5-2620v4 2.1GHZ	192	RAID 1 – 927 GB RAID 5 – 10.6 TB	N/A	PO DC
1919/SVR/0073	Dell PowerEdge R730	N/A	Intel E5-2620v4 2.1GHZ	16	RAID 1 – 1 TB	N/A	PO DC

1919/SVR/0074	Dell PowerEdge R730	N/A	Intel E5-2620v4 2.1GHZ	16	RAID 1 – 1 TB	N/A	PO DC
1919/SVR/0075	Dell PowerEdge R730	N/A	Intel E5-2620v4 2.1GHZ	16	RAID 1 – 1 TB	N/A	PO DC
1919/SVR/0076	Dell PowerEdge R730	N/A	Intel E5-2620v4 2.1GHZ	16	RAID 1 – 1 TB	N/A	PO DC
1919/SVR/0077	Dell PowerEdge R730	N/A	Intel E5-2620v4 2.1GHZ	16	RAID 1 – 1 TB	N/A	PO DC
1919/SVR/0078	Dell PowerEdge R730	N/A	Intel E5-2620v4 2.1GHZ	16	RAID 1 – 1 TB	N/A	PO DC
1919/SVR/0079	Dell PowerEdge R730	N/A	Intel E5-2620v4 2.1GHZ	16	RAID 1 – 1 TB	N/A	PO DC
1919/SVR/0080	Dell PowerEdge R730	N/A	Intel E5-2620v4 2.1GHZ	16	RAID 1 – 1 TB	N/A	PO DC
1919/SVR/0081	HP Proliant DL380P G9	N/A	Intel E5-2620v4 2.1GHz	16	RAID 5 – 558 GB	N/A	PO DC
1919/SVR/0082	HP Proliant DL380P G9	N/A	Intel E5-2620v4 2.1GHz	16	RAID 5 – 558 GB	N/A	PO DC
1919/SVR/0083	Huawei RH2288H 3	N/A	N/A	N/A	N/A	N/A	PO DC

Asset Tag	Manufacturer / Model	Year	CPU	RAM [GB]	Disks – RAID	IPMI IP	Location
1919/SVR/0084	Huawei RH2288H 3	N/A	N/A	N/A	N/A	N/A	PO DC
1919/SVR/0085	Dell PowerEdge R930	N/A	Intel E7-4820v3 1.90GHz	64	RAID 5 – 3.7 TB	N/A	PO DC
N/A	HP Proliant DL380 G5	N/A	N/A	N/A	N/A	N/A	HO
N/A	Dell PowerEdge T110 II	N/A	N/A	N/A	N/A	N/A	Accra West
N/A	HP Pro 3500	N/A	N/A	N/A	N/A	N/A	Accra West
N/A	Dell OptiPlex 380	N/A	N/A	N/A	N/A	N/A	Accra West
N/A	HP Pro 3500	N/A	N/A	N/A	N/A	N/A	Accra West
N/A	Dell OptiPlex 380	N/A	N/A	N/A	N/A	N/A	Accra West
N/A	Dell PowerEdge T110	N/A	N/A	N/A	N/A	N/A	Accra West
N/A	Dell PowerEdge R720	N/A	N/A	N/A	N/A	N/A	Accra West
N/A	HP Pro 3500	N/A	N/A	N/A	N/A	N/A	Ashanti E
N/A	Dell OptiPlex 380	N/A	N/A	N/A	N/A	N/A	Ashanti E
N/A	Dell OptiPlex 380	N/A	N/A	N/A	N/A	N/A	Ashanti E
N/A	HP Pro 3330 MT	N/A	N/A	N/A	N/A	N/A	Ashanti W
N/A	Dell PowerEdge SC440	N/A	N/A	N/A	N/A	N/A	Ashanti W
N/A	HP PRO 3500	N/A	N/A	N/A	N/A	N/A	Ashanti W
N/A	Dell PowerEdge T110	N/A	N/A	N/A	N/A	N/A	Ashanti W
N/A	Dell PowerEdge	N/A	N/A	N/A	N/A	N/A	Cape Coast
N/A	HP Pro 3500	N/A	N/A	N/A	N/A	N/A	Central
N/A	Dell PowerEdge T110	N/A	N/A	N/A	N/A	N/A	Central
N/A	Dell OptiPlex 380	N/A	N/A	N/A	N/A	N/A	Central
N/A	Dell PowerEdge R710	N/A	N/A	N/A	N/A	N/A	Central

N/A	Dell PowerEdge T320	N/A	N/A	N/A	N/A	N/A	Central
N/A	Dell PowerEdge R720	N/A	N/A	N/A	N/A	N/A	Central
N/A	Dell PowerEdge R710	N/A	N/A	N/A	N/A	N/A	Central
N/A	Dell PowerEdge R710	N/A	N/A	N/A	N/A	N/A	Central
N/A	HP Pro 3500	N/A	N/A	N/A	N/A	N/A	Eastern
N/A	Dell PowerEdge SC440	N/A	N/A	N/A	N/A	N/A	Eastern
N/A	Dell OptiPlex 380	N/A	N/A	N/A	N/A	N/A	Eastern
N/A	Dell PowerEdge R720	N/A	N/A	N/A	N/A	N/A	Eastern
N/A	Dell OptiPlex 3020	N/A	N/A	N/A	N/A	N/A	Eastern
N/A	Dell PowerEdge R710	N/A	N/A	N/A	N/A	N/A	Eastern
N/A	HP Pro	N/A	N/A	N/A	N/A	N/A	Tema
N/A	HP ProDesk 400 G1	N/A	N/A	N/A	N/A	N/A	Tema
N/A	Dell PowerEdge T110	N/A	N/A	N/A	N/A	N/A	Tema
N/A	Dell PowerEdge SC440	N/A	N/A	N/A	N/A	N/A	Tema
N/A	Dell PowerEdge SC440	N/A	N/A	N/A	N/A	N/A	Tema
N/A	PowerEdge R710	N/A	N/A	N/A	N/A	N/A	Volta
N/A	PowerEdge R710	N/A	N/A	N/A	N/A	N/A	Volta
N/A	HP Pro3500 Series	N/A	N/A	N/A	N/A	N/A	Volta
N/A	HP Pro3500 Series	N/A	N/A	N/A	N/A	N/A	Volta
N/A	Dell OptiPlex 380	N/A	N/A	N/A	N/A	N/A	Volta
N/A	HP ProLiant ML310eG8	N/A	N/A	N/A	N/A	N/A	Volta
N/A	HP Pro 3500	N/A	N/A	N/A	N/A	N/A	Western
N/A	Dell OptiPlex 380	N/A	N/A	N/A	N/A	N/A	Western
N/A	Dell PowerEdge T110 II	N/A	N/A	N/A	N/A	N/A	Western

8.3   Virtualisation Environment

PDS operates three virtualisation solutions: Citrix XenServer, Microsoft Hyper-V and VMware ESXi. Both the Hyper-V and ESXi system at PDS are setup using local disks only (no shared storage). The ICT BU did not provide information whether the XenServer systems are sharing any storage infrastructure.

PDS does not use any software for centralised management of its virtualisation environment. Solutions to improve virtualisation control, such as distributed resource schedulers, automated recovery and monitoring solutions are not deployed at PDS.

8.3.1   Virtualisation Software

Table 86: Virtualisation Software

Vendor	Product	Version	Comment
Microsoft	Hyper-V	Various	No management software
VMware	ESXi	N/A	No management software
Citrix	XenServer	6.5	No management software

8.3.2   Virtualisation Hosts

8.3.2.1   Citrix Hosts

Table 87: Citrix Virtualisation Hosts

Hostname	Asset Tag	Version	Mgmt. IP	VM Networks	Datastores - Size	Purpose
PROMPPXHY01	1919/SVR/0050	XenServer 6.5	N/A	N/A	N/A	InCMS
PROMPPXHY02	1919/SVR/0049	XenServer 6.5	N/A	N/A	N/A	InCMS
PROMPPXHY03	1919/SVR/0056	XenServer 6.5	N/A	N/A	N/A	InCMS

Table 88: XenServer Cluster

Cluster Name	Cluster IP	Nodes - IPs	Shared Volumes - Size	Networks
None				

Table 89: XenServer Shared Volumes

Datastores	Size	File System	Host	Virtual Machines
None				

8.3.2.2   Microsoft Hosts

Table 90: Hyper-V Virtualisation Hosts

Hostname	Asset Tag	Version	Mgmt. IP	VM Networks	Datastores - Size	Purpose
ALPHAHOST01	1919/SVR/0007	2012 R2 Core	N/A	N/A	1.09 TB	Alpha Metering
Hostname	**Asset Tag**	**Version**	**Mgmt. IP**	**VM Networks**	**Datastores - Size**	**Purpose**
ALPHAHOST02	1919/SVR/0008	2012 R2 Core	N/A	N/A	1.09 TB	Alpha Metering
BOTREPLICA	1919/SVR/0067	2016 Core	N/A	N/A	10.91 TB	BOT
BXCMNGMT03	1919/SVR/0003	2012 R2 DC	N/A	N/A	1.09 TB	BXC
BXCMNGMT04	1919/SVR/0004	2012 R2 DC	N/A	N/A	4.55 TB	BXC
BXCMNGMT1	1919/SVR/0002	2012 R2 DC	N/A	N/A	3.27 TB	BXC
BXCTEST	1919/SVR/0068	2016 Core	N/A	N/A	10.91 TB	BOT
ECASHHOST	1919/SVR/0032	2016 Core	N/A	N/A	2.18 TB	Other
EXCHANGEHOST	1919/SVR/0001	2016 Core	N/A	N/A	3 TB	BXC
HOLLEYHOST11	1919/SVR/0027	2012 R2 Core	N/A	N/A	3.27 TB	HOLLEY
HOLLEYHOST12	1919/SVR/0029	2012 R2 Core	N/A	N/A	4.55 TB	Holley Metering
HOST05	1919/SVR/0033	2016 Core	N/A	N/A	2.18 TB	Other
HOST1	1919/SVR/0031	2012 R2 Core	N/A	N/A	2.0 TB	Other
HOST182016	1919/SVR/0010	2016 Core	N/A	N/A	N/A	ICT
HOST2	1919/SVR/0030	2012 R2 Core	N/A	N/A	2.73 TB	Other

HOST3	1919/SVR/0019	2012 R2 DC	N/A	N/A	N/A	Other
IMEXMAIN	1919/SVR/0081	2016 Core	N/A	N/A	558 GB	IMEX
IMEXREPLICA	1919/SVR/0082	2016 Core	N/A	N/A	558 GB	IMEX
PROMPPOHY01	1919/SVR/0053	2008 R2	N/A	N/A	N/A	InCMS
PROMPPOHY02	1919/SVR/0052	2008 R2	N/A	N/A	N/A	InCMS
PROMPPOHY03	1919/SVR/0051	2008 R2	N/A	N/A	N/A	InCMS
SUNREPLICA1	1919/SVR/0069	2016 Core	N/A	N/A	10.91 TB	SUN
SUNSVRMAIN1	1919/SVR/0071	2012 R2 Core	N/A	N/A	10.91 TB	SUN
TAAHOST	1919/SVR/0070	2008 R2	N/A	N/A	4.37 TB / 4.37 TB	TAA

Table 91: Hyper-V Cluster

Cluster Name	Cluster IP	Nodes - IPs	Shared Volumes - Size	Networks
None				

Table 92: Hyper-V Shared Volumes

Datastores	Size	File System	Host	Virtual Machines
None				

8.3.2.3   VMware Hosts

Table 93: VMware Virtualisation Hosts

Hostname	Asset Tag	Version	Mgmt. IP	VM Networks	Datastores - Size	Purpose
BISVR	1919/SVR/0015	ESXi	N/A	N/A	1.82 TB	Business Intelligence
ERPHOST02	1919/SVR/0009	ESXi	N/A	N/A	1.82 TB	ICT
FTPHOST	1919/SVR/0020	ESXi	N/A	N/A	398 GB	Other
HOST4	1919/SVR/0028	ESXi	N/A	N/A	6.54 TB	Other
HOST8	1919/SVR/0013	ESXi	N/A	N/A	1.81 TB	ICT Infrastructure Mgt
MTSHOST1	1919/SVR/0017	ESXi	N/A	N/A	1.64 TB	MTS
WEBHOST01	1919/SVR/0036	ESXi	N/A	N/A	N/A	HOLLEY
Hostname	**Asset Tag**	**Version**	**Mgmt. IP**	**VM Networks**	**Datastores - Size**	**Purpose**
WEBHOST02	1919/SVR/0037	ESXi	N/A	N/A	N/A	HOLLEY

Table 94: VMware Cluster

Cluster Name	Cluster IP	Nodes - IPs	Shared Volumes - Size	Networks
None				

Table 95: VMware Shared Datastores

Datastores	Size	File System	Host	Virtual Machines
None				

8.3.3 Virtual Machines

The ICT BU operates a total of 174 Virtual Machines (VMs) of which most are running server Operating Systems (refer the table that follows). Critical information, such as the configured CPUs, were in many instances not made available by the ICT BU.

Table 96: Virtual Machines

VM Name	Physical Host	vCPU	RAM [GB]	Disks [GB]	NICs
ADEMPIERE	ERPHOST2	1	16	216	1
ADEMPIERE LIVE SVR	HOST4	4	8	500	2
ADEMPIERE TESTSVR	HOST4	4	2.93	150	1
ADManager	HOST8	4	4	205	1
ADOIT	BXCMNGMT03	N/A	8	300	1
ADONISNP	BXCMNGMT03	N/A	16	300	1
ALPHA_01	ALPHAHOST02	N/A	12	1 TB	1
ALPHA02	ALPHAHOST01	N/A	12	1 TB	1
ALPHA03	ALPHAHOST01	N/A	4	200	1
ALPHA04	ALPHAHOST01	N/A	4	150	1
ALPHA05	ALPHAHOST01	N/A	4	150	1
AMR REPLICA DB	HOST8	8	32	710	1
BI V2	BISVR	16	32	632	1
BILL PAYMENTMAIN	BXCMNGMT04	N/A	64	1 TB	1
BILL PAYMENTS	ERPHOST2	8	3	200	1
BILLPAYARCH	BXCTEST	N/A	1	700	1
BISRV11_PDS	BISVR	8	32	632	1
BISRV11_PDS(TEST)	BISVR	8	32	632	1
BOT APPS	BXCMNGMT1	N/A	4	500	1
BOT CSM	BXCMNGMT1	N/A	4	500	1
BOT DB	BXCMNGMT1	N/A	4	500	1
BOT_BACKUPRESTORE	BXCMNGMT03	N/A	4	70	1
BOTBACKUP-DR	BOTREPLICA	N/A	32	1000	1
BOTCMS-DR	BOTREPLICA	N/A	32	1000	1
VM Name	Physical Host	vCPU	RAM [GB]	Disks [GB]	NICs

BOTDR	BOTREPLICA	N/A	32	1000	1
BOTVPN01	BXCMNGMT1	N/A	4	500	1
BOTVPN02	BXCMNGMT03	N/A	16	500	1
BSC	BXCMNGMT03	N/A	10	250	1
BSC01	BXCMNGMT03	N/A	16	250	1
BSC01	HOST05	N/A	16	250	1
BXC InCMS	BXCMNGMT1	N/A	4	500	1
BXCDB1	BXCMNGMT1	N/A	4	500	1
BXCDB2	BXCMNGMT1	N/A	4	200	1
CentOS	FTPHOST	2	2	102	1
CERT SVR 08	HOST1	N/A	4	100	1
CITRIXTESTING	ERPHOST2	1	4	74	1
InCMS FTP SERVER	FTPHOST	2	4	184	1
InCMS FTP SERVER-RCVD	HOST4	1	4	200	2
CMSVR 23	TAAHOST	N/A	N/A	N/A	N/A
CMSVR 24	TAAHOST	N/A	N/A	N/A	N/A
DATABASE 1	HOLLEYHOST11	N/A	70	2 TB	1
DATABASE 1	HOLLEYHOST12	N/A	70	200	1
DATABASE 2	HOLLEYHOST11	N/A	70	200	1
DATABASE1	HOLLEYHOST12	N/A	70	2 TB	1
DATABASE2	HOLLEYHOST12	N/A	30	500	1
DATAGUARD	HOST8	1	8	107	1
D-AUTO	BXCTEST	N/A	4	500	1
DBLAB	ECASHHOST	N/A	8	500	1
DCKASPSVR	HOST2	N/A	8	250	1
DEV TESTING SVR	HOST4	2	4	200	2
D-UATSVR	HOST05	N/A	2	100	1
DUDE1	HOST1	N/A	4	50	1
E-CASH API TESTSVR	HOST4	8	4	200	1
ECASHCOM	BXCTEST	N/A	16	500	1
PDS TAA PROJECTRECOVERED	HOST1	N/A	12	300	1
PDS_GEM_WESVR	HOST4	8	8	465	2
PDS-DB-VM	HOST1	N/A	4	140	1
PDSDOCKER	BXCMNGMT03	N/A	512	127	1
PDS-ORCLSVR	HOST1	N/A	4	106	1
PDS-ORCLSVR	HOST2	N/A	4	106	N/A
PDSWEB	HOST4	2	8	150	1
PDSWEB-BACKUP	FTPHOST	1	1	53	1
E-LIBRARY	ERPHOST2	4	4	124	1

ERPSTAG	ERPHOST2	1	6	218	1
ERPSVR	HOST2	N/A	8	100	
ERPSVR02	HOST4	1	4	100	1
EXCHANGE SVR2013B	EXCHANGEHOST	N/A	65	300	1
EXCHANGE SVR2013B	EXCHANGEHOST	N/A	65	1.39 TB	1
EXT WEBSITE	MTSHOST1	8	10	100	1
GOV-HERITAGE	HOST1	N/A	2	60	1

VM Name	Physical Host	vCPU	RAM [GB]	Disks [GB]	NICs
GRID MONITORING SCADA	HOST4	8	2	50	1
HOST 12 DATABASE 1	BXCMNGMT03	N/A	4	500	1
HRSVR	HOST8	4	6	256	1
IMES2016	BXCMNGMT03	N/A	4	1.8 TB	1
IMEXCOM	IMEXMAIN	N/A	5	160	N/A
IMEXCOM	IMEXREPLICA	N/A	5	160	N/A
IMEXDB	IMEXMAIN	N/A	8	341	N/A
IMEXDB	IMEXREPLICA	N/A	8	341	N/A
IMS-2010	HOST1	N/A	8	150	1
IMS-2010	HOST2	N/A	16	150	N/A
IMSSQL	HOST1	N/A	8	200	1
IMSSQL	HOST2	N/A	16	200	N/A
INTRANET	HOST1	N/A	8	150	1
INTRANET	HOST2	N/A	4	300	N/A
INTRANET 2013	HOST2	N/A	32	250	N/A
INTRANET 2013 SQL	HOST2	N/A	16	60	N/A
INTRANET 2013 SQL	HOST2	N/A	16	300	N/A
ITOPNEW	HOST4	4	4	100	1
ITOPSVRTEST	ERPHOST2	4	4	469	1
KASOAECASH	ECASHHOST	N/A	64	750	1
KASPERSKY SecCenter	HOST1	N/A	4	250	1
KASPERSKY SecCenter	HOST2	N/A	4	250	N/A
L&R TEST	HOST4	8	4	500	2
LA-SVM	BISVR	4	2	32	1
LOGS_MIKROTIK	HOST2	N/A	4	100	
MBH PROVISION1	BXCMNGMT1	N/A	4	500	1
MIECOMMSVR	HOST05	N/A	2	250	1
MIEDBSVR	HOST05	N/A	12	250	1
MOE SVR	HOST2	N/A	5	50	N/A

MONITORING SVR	HOST05	N/A	2	250	1
MTS CLOUD PROJ2MONSVR	HOST4	8	2	50	1
MTS1 RD CLT	MTSHOST1	4	34	620	1
MTS2 DB	MTSHOST1	8	16.5	700	1
MTS3 APP	MTSHOST1	32	16.5	116	1
MTS4	MTSHOST1	1	16	62	1
MTSCLOUDPROJECTFRONT	HOST2	N/A	4	50	N/A
MTSCLOUDPROJECTFRONT-02	HOST2	N/A	8	50	N/A
MTSCLOUDPROJECT-INTEG	HOST2	N/A	2	20	N/A
MTSCLOUDPROJECTSMONITOR	HOST2	N/A	2	30	N/A
MTSCLOUDPROJECTWEBSERV	HOST2	N/A	2	20	N/A
MTSDLOUDPROJECT-DB	HOST2	N/A	4	300	N/A
MULTIDRIVE COMM SVR1	FTPHOST	1	6	86	1
MULTIDRIVE COMM SVR1	HOST4	4	6	120	2

VM Name	Physical Host	vCPU	RAM [GB]	Disks [GB]	NICs
NEW VIRTUAL MACHINE	HOST8	1	2	18	1
newclou1	HOST2	N/A	8	100	N/A
newclou2	HOST2	N/A	8	100	N/A
newclou3	HOST2	N/A	4	100	N/A
NEWCLOU4	HOST2	N/A	4	100	N/A
NEWPOSSVR	HOST05	N/A	2	200	1
NEWPOWERHUB	HOST05	N/A	4	300	1
NURIDBTEST	ECASHHOST	N/A	10	500	1
OPERATIONS SEVER	ERPHOST2	1	2	52	1
ORACLE _DB	HOST8	1	6	225	1
ORACLE STBY	HOST8	1	2	252	1
PAYMENT PLATFORM	HOST1	N/A	4	100	1
POSSVR	HOST05	N/A	2	150	1
POWER HUB	HOST1	N/A	2	80	1
PRO-CASSVR	HOST1	N/A	32	150	1
PRO-CASSVR	HOST2	N/A	6	100	
PROMPPXHY01	PROMPPXHY01	N/A	384	267	N/A
PROMPPXHY02	PROMPPXHY02	N/A	8	40	N/A
PROMPVLMG01	HOST8	2	8	28	1
PROMPVLMG01_BK	HOST8	2	4	24	1

PROMPVWDCPPMS02	HOST2	N/A	4	127	N/A
PROPPPWMX03-EXCH ARCH	HOST4	8	8	2.34 TB	2
PROPPVWCT01	PROMPPXHY01	N/A	48	40	N/A
PROPPVWCT01	PROMPPXHY01	N/A	48	40	N/A
PROPPVWCT02	PROMPPXHY01	N/A	32	40	N/A
PROPPVWCT03	PROMPPXHY01	N/A	32	40	N/A
PROPPVWCT04	PROMPPXHY01	N/A	32	40	N/A
PROPPVWCT06	PROMPPXHY02	N/A	16	40	N/A
PROPPVWCT07	PROMPPXHY02	N/A	32	40	N/A
PROPPVWCT08	PROMPPXHY02	N/A	32	40	N/A
PROPPVWCT09	PROMPPXHY02	N/A	32	40	N/A
PROPPVWCT10	PROMPPXHY02	N/A	16	40	N/A
PROPPVWDC01	PROMPPXHY01	N/A	16	40	N/A
PROPPVWDC03	HOST1	N/A	4	100	1
PROPPVWDC03	HOST2	N/A	4	100	N/A
PROPPVWMM01	ERPHOST2	1	12	72	1
REPO1	HOST1	N/A	8	150	1
RMR	HOST4	8	16	887	1
SEAL MNGMT DBSVR	HOST05	N/A	2	250	1
SEAL MNGMT SYS-APP01	HOST05	N/A	2	150	1
SMAPSVR	BXCMNGMT1	N/A	4	127	1
SMS	BXCMNGMT03	N/A	4	200	1
SOPHOS EMAIL	HOST4	8	8	100	1
SSA-ACCRAEW1	HOST4	4	4	200	1
SUNAPPSVR	SUNSVRMAIN1	N/A	64	500	1
SUNDBSVR	SUNSVRMAIN1	N/A	32	300	1
VM Name	**Physical Host**	**vCPU**	**RAM [GB]**	**Disks [GB]**	**NICs**
SUNDBSVR	SUNSVRMAIN1	N/A	32	1.98 TB	1
SUNDBSVR	SUNSVRMAIN1	N/A	32	1.02 TB	1
SUNWEBSVR	SUNSVRMAIN1	N/A	32	250	1
TAA FEPORTS ALL-OLD	BXCMNGMT03	N/A	32	601	1
TAA TRAINING 1	HOST05	N/A	160	150	N/A
TAA_ALL BACKUPS	BXCMNGMT03	N/A	4	1.76 TB	1
TAA-PROD-EASOLTEM	BXCMNGMT1	N/A	16	1.95 TB	1
TAAREPWESAUG2018	BXCMNGMT03	N/A	12	500	1
TEMAECASH	ECASHHOST	N/A	128	1.95 TB	1
VEEAM	ERPHOST2	4	32	161	1
WGOLD	HOST1	N/A	4	150	1
WIN SVR2008 R2	HOST8	2	2	82	1

WIN2008	BXCMNGMT03	N/A	16	127	1
WORKBENCH	BXCMNGMT03	N/A	16	200	N/A
WORKBENCH 2	BXCMNGMT03	N/A	16	1.17 TB	1

8.4   Microsoft Windows Server Infrastructure

8.4.1   Server and OS Summary

Critical information, such as the purpose of the VMs and the Hostname, were in many instances not made available by the ICT BU. Refer also to section 8.6 for VMs that neither be allocated to Windows nor the Linux/UNIX environment.

Table 97: Server OS & Purpose – Windows

Hostname	Asset Tag or Host Server	Type	IP Address	OS	Purpose
N/A	1919/SVR/0026	PS	N/A	WinSvr 2012 R2 Core	Other
BOT DISASTER	1919/SVR/0016	PS	N/A	N/A	ICT Application Mgt
BOT_SVR	1919/SVR/0085	PS	N/A	WinSvr 2012 R2 Std.	BOT
HUAWEI1	1919/SVR/0083	PS	N/A	N/A	HUAWEI
HUAWEI2	1919/SVR/0084	PS	N/A	N/A	HUAWEI
HVMNGR3	1919/SVR/0021	PS	N/A	WinSvr 2012 R2 DC	Other
MBH01	1919/SVR/0073	PS	N/A	WinSvr 2008 R2	MBH
MBH02	1919/SVR/0074	PS	N/A	WinSvr 2008 R2	MBH
MBH03	1919/SVR/0075	PS	N/A	WinSvr 2008 R2	MBH
MBH04	1919/SVR/0076	PS	N/A	WinSvr 2008 R2	MBH
MBH05	1919/SVR/0077	PS	N/A	WinSvr 2008 R2	MBH
MBH06	1919/SVR/0078	PS	N/A	WinSvr 2008 R2	MBH
MBH07	1919/SVR/0079	PS	N/A	WinSvr 2008 R2	MBH
MBH08	1919/SVR/0080	PS	N/A	WinSvr 2008 R2	MBH
MNGMT2	1919/SVR/0018	PS	N/A	WinSvr 2012 R2 DC	Other

Hostname	Asset Tag or Host Server	Type	IP Address	OS	Purpose
Storage1	1919/SVR/0025	PS	N/A	WinSvr 2012 R2 DC	Other
WIN2008	BXCMNGMT03	VM	N/A	WinSrv 2008	N/A
ERPSTAG	ERPHOST2	VM	N/A	WinSrv 2003	N/A
OPERATIONS SEVER	ERPHOST2	VM	N/A	WinSrv 2003	N/A
MTS4	MTSHOST1	VM	N/A	WinSrv 2008	N/A
ADEMPIERE TESTSVR	HOST4	VM	N/A	WinSrv 2008 R2	N/A
ADManager	HOST8	VM	N/A	WinSrv 2008 R2	AD Management
AMR REPLICA DB	HOST8	VM	N/A	WinSrv 2008 R2	N/A

BI V2	BISVR	VM	N/A	WinSrv 2008 R2	N/A
BILL PAYMENTS	ERPHOST2	VM	N/A	WinSrv 2008 R2	Bill Payments
BISRV11_PDS	BISVR	VM	N/A	WinSrv 2008 R2	N/A
BISRV11_PDS(TEST)	BISVR	VM	N/A	WinSrv 2008 R2	N/A
InCMS FTP SERVER	FTPHOST	VM	N/A	WinSrv 2008 R2	N/A
InCMS FTP SERVER-RCVD	HOST4	VM	N/A	WinSrv 2008 R2	N/A
CMSVR 23	TAAHOST	VM	N/A	WinSrv 2008 R2	N/A
CMSVR 24	TAAHOST	VM	N/A	WinSrv 2008 R2	N/A
DEV TESTING SVR	HOST4	VM	N/A	WinSrv 2008 R2	N/A
E-CASH API TESTSVR	HOST4	VM	N/A	WinSrv 2008 R2	N/A
PDSWEB(WebService)	HOST4	VM	N/A	WinSrv 2008 R2	N/A
PDSWEB-BACKUP	FTPHOST	VM	N/A	WinSrv 2008 R2	N/A
ERPSVR02	HOST4	VM	N/A	WinSrv 2008 R2	N/A
EXT WEBSITE	MTSHOST1	VM	N/A	WinSrv 2008 R2	Ext. Website
GRID MONITORING SCADA	HOST4	VM	N/A	WinSrv 2008 R2	N/A
ITOPNEW	HOST4	VM	N/A	WinSrv 2008 R2	N/A
ITOPSVRTEST	ERPHOST2	VM	N/A	WinSrv 2008 R2	ICT ITSM
KASPERSKY SecCenter	HOST1	VM	N/A	WinSrv 2008 R2	N/A
KASPERSKY SecCenter	HOST2	VM	N/A	WinSrv 2008 R2	N/A
L&R TEST	HOST4	VM	N/A	WinSrv 2008 R2	N/A
MTS CLOUD PROJ2-MONSVR	HOST4	VM	N/A	WinSrv 2008 R2	N/A
MTS1 RD CLT	MTSHOST1	VM	N/A	WinSrv 2008 R2	N/A
MTS2 DB	MTSHOST1	VM	N/A	WinSrv 2008 R2	N/A
MTS3 APP	MTSHOST1	VM	N/A	WinSrv 2008 R2	N/A
MTSCLOUDPROJECT-FRONT	HOST2	VM	N/A	WinSrv 2008 R2	N/A
MTSCLOUDPROJECT-FRONT-02	HOST2	VM	N/A	WinSrv 2008 R2	N/A
MTSCLOUDPROJECT-INTEG	HOST2	VM	N/A	WinSrv 2008 R2	N/A
MTSCLOUDPROJECTSMONITOR	HOST2	VM	N/A	WinSrv 2008 R2	N/A
MTSCLOUDPROJECT-WEBSERV	HOST2	VM	N/A	WinSrv 2008 R2	N/A
MTSDLOUDPROJECT-DB	HOST2	VM	N/A	WinSrv 2008 R2	N/A
MULTIDRIVE COMM SVR1	FTPHOST	VM	N/A	WinSrv 2008 R2	N/A
MULTIDRIVE COMM SVR1	HOST4	VM	N/A	WinSrv 2008 R2	N/A
ORACLE _DB	HOST8	VM	N/A	WinSrv 2008 R2	N/A
PROMPPXHY02	PROMPPXHY02	VM	N/A	WinSrv 2008 R2	N/A
PROPPPWMX03-EXCH ARCH	HOST4	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWCT01	PROMPPXHY01	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWCT01	PROMPPXHY01	VM	N/A	WinSrv 2008 R2	N/A

Hostname	Asset Tag or Host Server	Type	IP Address	OS	Purpose

PROPPVWCT02	PROMPPXHY01	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWCT03	PROMPPXHY01	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWCT04	PROMPPXHY01	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWCT06	PROMPPXHY02	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWCT07	PROMPPXHY02	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWCT08	PROMPPXHY02	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWCT09	PROMPPXHY02	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWCT10	PROMPPXHY02	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWDC01	PROMPPXHY01	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWDC03	HOST1	VM	N/A	WinSrv 2008 R2	N/A
PROPPVWMM01	ERPHOST2	VM	N/A	WinSrv 2008 R2	N/A
RMR	HOST4	VM	N/A	WinSrv 2008 R2	N/A
SSA-ACCRAEW1	HOST4	VM	N/A	WinSrv 2008 R2	N/A
VEEAM	ERPHOST2	VM	N/A	WinSrv 2008 R2	N/A
WGOLD	HOST1	VM	N/A	WinSrv 2008 R2	N/A
WIN SVR2008 R2	HOST8	VM	N/A	WinSrv 2008 R2	N/A
CITRIXTESTING	ERPHOST2	VM	N/A	WinSrv 2012	N/A
PDS_GEM_WESVR	HOST4	VM	N/A	WinSrv 2012	N/A
ADOIT	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
ADONISNP	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
ALPHA_01	ALPHAHOST02	VM	N/A	WinSrv 2012 R2	N/A
ALPHA02	ALPHAHOST01	VM	N/A	WinSrv 2012 R2	N/A
ALPHA03	ALPHAHOST01	VM	N/A	WinSrv 2012 R2	N/A
ALPHA04	ALPHAHOST01	VM	N/A	WinSrv 2012 R2	N/A
ALPHA05	ALPHAHOST01	VM	N/A	WinSrv 2012 R2	N/A
BILL PAYMENTMAIN	BXCMNGMT04	VM	N/A	WinSrv 2012 R2	N/A
BOT APPS	BXCMNGMT1	VM	N/A	WinSrv 2012 R2	N/A
BOT CSM	BXCMNGMT1	VM	N/A	WinSrv 2012 R2	N/A
BOT DB	BXCMNGMT1	VM	N/A	WinSrv 2012 R2	N/A
BOT_BACKUPRESTORE	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
BOTVPN01	BXCMNGMT1	VM	N/A	WinSrv 2012 R2	N/A
BOTVPN02	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
BSC	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
BSC01	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
BXC InCMS	BXCMNGMT1	VM	N/A	WinSrv 2012 R2	N/A
BXCDB1	BXCMNGMT1	VM	N/A	WinSrv 2012 R2	N/A
BXCDB2	BXCMNGMT1	VM	N/A	WinSrv 2012 R2	N/A
PDSDOCKER	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
HOST 12 DATABASE 1	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
IMES2016	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A

MBH PROVISION1	BXCMNGMT1	VM	N/A	WinSrv 2012 R2	N/A
SMAPSVR	BXCMNGMT1	VM	N/A	WinSrv 2012 R2	N/A
SMS	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
SUNAPPSVR	SUNSVRMAIN1	VM	N/A	WinSrv 2012 R2	N/A
SUNDBSVR	SUNSVRMAIN1	VM	N/A	WinSrv 2012 R2	N/A
SUNDBSVR	SUNSVRMAIN1	VM	N/A	WinSrv 2012 R2	N/A
SUNDBSVR	SUNSVRMAIN1	VM	N/A	WinSrv 2012 R2	N/A
Hostname	**Asset Tag or Host Server**	**Type**	**IP Address**	**OS**	**Purpose**
SUNWEBSVR	SUNSVRMAIN1	VM	N/A	WinSrv 2012 R2	N/A
TAA FEPORTS ALL-OLD	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
TAA_ALL BACKUPS	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
TAA-PROD-EASOLTEM	BXCMNGMT1	VM	N/A	WinSrv 2012 R2	N/A
TAAREPWESAUG2018	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
WORKBENCH	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
WORKBENCH 2	BXCMNGMT03	VM	N/A	WinSrv 2012 R2	N/A
INTRANET 2013 SQL	HOST2	VM	N/A	WinSrv 2012 R2	N/A
INTRANET 2013 SQL	HOST2	VM	N/A	WinSrv 2012 R2	N/A
E-LIBRARY	ERPHOST2	VM	N/A	Win 7	PDS E-Library

Type: PS = Physical Server, VM = Virtual Machine

8.4.1.1 Server Details

No further details about the Windows servers were provided.

8.4.2 Special Server Services

Only services that neither form part of a standard Windows Server setup nor are part of typical off-the-shelf application installed on the servers are documented here.

No information in regard to special Windows Server services were provided by the ICT BU. Table 98: Special Server Services

Hostname	Service Name	Purpose
N/A		

8.4.3 Security Model

Most servers are joined to PDS's AD. Some servers, such as the pre-paid systems, are not joined to the AD (workgroup members) and are using local authentication mechanisms.

8.4.4 Login/Startup Scripts

No Login/Startup Scripts are in use for the Windows Servers of PDS.

8.4.5 Name Resolution

Most Windows Server are using the Active Directory integrated DNS service deployed at PDS. Some servers that are not joined to domain use HOSTS files.

8.4.6 Shared Resources

8.4.6.1 Distributed File System

Not in use.

8.4.6.2 File Shares

No information has been made available whether Windows Server file shares are being used for user data, such as users' home, shared folders for business units or other purposes. No naming convention exists for file share names.

Table 99: File Shares excl. System Shares – Windows

Hostname	Share Name	Directory / Folder	Purpose
N/A	N/A	N/A	N/A

Excludes standard / system shares, such as the root shares of disk drives (e.g. C$)

8.4.6.3 Printer Shares

PDS has not deployed any print servers. Jobs are sent directly to network printers. No naming convention exists for printer share names.

No naming convention exists for printer share names.

Table 100: Print Queues – Windows

Hostname	Share Name	Printer	Driver	Printer Location
None				

8.4.6.4 File and Printer Quota Management

Not in use.

8.5 Linux/UNIX Server Infrastructure

8.5.1 Server and OS Summary

Critical information, such as the purpose of the VMs and the Hostname, were in many instances not made available by the ICT BU. Refer also to section 8.6 for VMs that can neither be allocated to Windows nor the Linux/UNIX environment.

Table 101: Server OS & Purpose – Linux/UNIX

Hostname	Asset Tag or Host Server	Type	IP Address	OS	Purpose
EBSDEV	1919/SVR/0061	PS	N/A	IBM AIX 7.1	Payroll Development
EBSPROD	1919/SVR/0060	PS	N/A	IBM AIX 7.1	Payroll Production
MOPSVR1	1919/SVR/0005	PS	N/A	Red Hat	Ministry of Power
MOPSVR2	1919/SVR/0006	PS	N/A	Red Hat	Ministry of Power
PROMPPLDB01	1919/SVR/0054	PS	N/A	Red Hat	InCMS
PROMPPLDB02	1919/SVR/0055	PS	N/A	Red Hat	InCMS
PROMPPLDB11	1919/SVR/0057	PS	N/A	Red Hat	InCMS
TKCBIS	1919/SVR/0059	PS	N/A	IBM AIX 7.1	CBIS
PROMPVLMG01	HOST8	VM	N/A	CentOS 4/5/6	
SOPHOS EMAIL	HOST4	VM	N/A	Linux	
MOE SVR	HOST2	VM	N/A	Red Hat 6	
ADEMPIERE	ERPHOST2	VM	N/A	Red Hat 6	Material Management
ADEMPIERE LIVE SVR	HOST4	VM	N/A	Red Hat 6	Material Management
CentOS	FTPHOST	VM	N/A	Red Hat 6	
DATAGUARD	HOST8	VM	N/A	Red Hat 6	
HRSVR	HOST8	VM	N/A	Red Hat 6	
NEW VIRTUAL MACHINE	HOST8	VM	N/A	Red Hat 6	
ORACLE STBY	HOST8	VM	N/A	Red Hat 6	
LA-SVM	BISVR	VM	N/A	Suse Linux Ent. 11	

Type: PS = Physical Server, VM = Virtual Machine

8.5.1.1 Server Details

No further details about the Linux/UNIX servers were provided.

8.5.2　Special Server Daemons

Only services that neither form part of a standard Linux/UNIX Server setup nor are part of typical off-the-shelf application installed on the servers are documented here.

No information in regard to special Linux/UNIX Server Daemons were provided by the ICT BU.

Table 102: Special Server Daemons

Hostname	Service Name	Purpose
N/A		

8.5.3　Security Model

All Linux/UNIX servers are standalone servers, not integrated with PDS's AD using local authentication mechanisms.

8.5.4　Login/Startup Scripts

No Login/Startup Scripts are in use for the Linux/UNIX servers of PDS.

8.5.5　Name Resolution

All Linux/UNIX Server are using the Active Directory integrated DNS service deployed at PDS.

8.5.6　Shared Resources

8.5.6.1　File Shares

No information has been made available whether Linux/UNIX file shares are being used for user data, such as users' home, shared folders for business units or other purposes.

No naming convention policy exists for file share names.

Table 103: File Shares excl. System Shares – Linux/UNIX

Hostname	Share Name	Directory / Folder	Purpose
None			

Excludes standard / system shares

8.5.6.2   Printer Shares

No print shares are published by the Linux/UNIOX servers of PDS.

No naming convention policy exists for printer share names.

Table 104: Print Queues – Linux/UNIX

Hostname	Share Name	Printer	Driver	Printer Location
None				

8.5.6.3   File and Printer Quota Management

Not in use.

8.6   Unknown Server Infrastructure

The table below lists servers for which the Operation System of the VM is unknown (information was not made available by the ICT BU). Furthermore, in many instances the Hostname, details regarding the purpose of the server and the Host Server of the Virtual Machines (VMs) were not supplied.

Table 105: Server OS & Purpose – Unknown Servers

Hostname	Asset Tag or Host Server	Type	IP Address	OS	Purpose
N/A	1919/SVR/0011	PS	N/A	N/A	ICT Application Management
N/A	1919/SVR/0012	PS	N/A	N/A	Holley Metering
N/A	1919/SVR/0014	PS	N/A	N/A	Holley Metering
N/A	1919/SVR/0022	PS	N/A	N/A	Other
N/A	1919/SVR/0023	PS	N/A	N/A	Other
N/A	1919/SVR/0024	PS	N/A	N/A	Other
N/A	1919/SVR/0034	PS	N/A	None	Other
N/A	1919/SVR/0035	PS	N/A	N/A	Holley Metering
N/A	1919/SVR/0058	PS	N/A	N/A	InCMS
N/A	1919/SVR/0062	PS	N/A	N/A	N/A
N/A	1919/SVR/0063	PS	N/A	N/A	N/A
N/A	1919/SVR/0064	PS	N/A	N/A	N/A
N/A	1919/SVR/0065	PS	N/A	N/A	N/A
N/A	1919/SVR/0066	PS	N/A	N/A	N/A
TAA	1919/SVR/0072	PS	N/A	N/A	TAA
BILLPAYARCH	BXCTEST	VM	N/A	N/A	N/A
BOTBACKUP-DR	BOTREPLICA	VM	N/A	N/A	N/A
BOTCMS-DR	BOTREPLICA	VM	N/A	N/A	N/A

BOTDR	BOTREPLICA	VM	N/A	N/A	N/A
BSC01	HOST05	VM	N/A	N/A	N/A
CERT SVR 08	HOST1	VM	N/A	N/A	N/A
DATABASE 1	HOLLEYHOST11	VM	N/A	N/A	N/A
DATABASE 1	HOLLEYHOST12	VM	N/A	N/A	N/A
DATABASE 2	HOLLEYHOST11	VM	N/A	N/A	N/A
DATABASE1	HOLLEYHOST12	VM	N/A	N/A	N/A
DATABASE2	HOLLEYHOST12	VM	N/A	N/A	N/A
D-AUTO	BXCTEST	VM	N/A	N/A	N/A
DBLAB	ECASHHOST	VM	N/A	N/A	N/A
DCKASPSVR	HOST2	VM	N/A	N/A	N/A
D-UATSVR	HOST05	VM	N/A	N/A	N/A
DUDE1	HOST1	VM	N/A	N/A	N/A
ECASHCOM	BXCTEST	VM	N/A	N/A	N/A
PDS TAA PROJECT-RECOVERED	HOST1	VM	N/A	N/A	N/A
PDS-DB-VM	HOST1	VM	N/A	N/A	N/A
PDS-ORCLSVR	HOST1	VM	N/A	N/A	N/A
PDS-ORCLSVR	HOST2	VM	N/A	N/A	N/A

Hostname	Asset Tag or Host Server	Type	IP Address	OS	Purpose
ERPSVR	HOST2	VM	N/A	N/A	N/A
EXCHANGE SVR2013B	EXCHANGEHOST	VM	N/A	N/A	N/A
EXCHANGE SVR2013B	EXCHANGEHOST	VM	N/A	N/A	N/A
GOV-HERITAGE	HOST1	VM	N/A	N/A	N/A
IMEXCOM	IMEXMAIN	VM	N/A	N/A	N/A
IMEXCOM	IMEXREPLICA	VM	N/A	N/A	N/A
IMEXDB	IMEXMAIN	VM	N/A	N/A	N/A
IMEXDB	IMEXREPLICA	VM	N/A	N/A	N/A
IMS-2010	HOST1	VM	N/A	N/A	N/A
IMS-2010	HOST2	VM	N/A	N/A	N/A
IMSSQL	HOST1	VM	N/A	N/A	N/A
IMSSQL	HOST2	VM	N/A	N/A	N/A
INTRANET	HOST1	VM	N/A	N/A	N/A
INTRANET	HOST2	VM	N/A	N/A	N/A
INTRANET 2013	HOST2	VM	N/A	N/A	N/A
KASOAECASH	ECASHHOST	VM	N/A	N/A	N/A
LOGS_MIKROTIK	HOST2	VM	N/A	N/A	N/A
MIECOMMSVR	HOST05	VM	N/A	N/A	N/A
MIEDBSVR	HOST05	VM	N/A	N/A	N/A

MONITORING SVR	HOST05	VM	N/A	N/A	N/A
newclou1	HOST2	VM	N/A	N/A	N/A
newclou2	HOST2	VM	N/A	N/A	N/A
newclou3	HOST2	VM	N/A	N/A	N/A
NEWCLOU4	HOST2	VM	N/A	N/A	N/A
NEWPOSSVR	HOST05	VM	N/A	N/A	N/A
NEWPOWERHUB	HOST05	VM	N/A	N/A	N/A
NURIDBTEST	ECASHHOST	VM	N/A	N/A	N/A
PAYMENT PLATFORM	HOST1	VM	N/A	N/A	N/A
POSSVR	HOST05	VM	N/A	N/A	N/A
POWER HUB	HOST1	VM	N/A	N/A	N/A
PRO-CASSVR	HOST1	VM	N/A	N/A	N/A
PRO-CASSVR	HOST2	VM	N/A	N/A	N/A
PROMPPXHY01	PROMPPXHY01	VM	N/A	N/A	N/A
PROMPVLMG01_BK	HOST8	VM	N/A	N/A	N/A
PROMPVWDCPPMS02	HOST2	VM	N/A	N/A	N/A
PROPPVWDC03	HOST2	VM	N/A	N/A	N/A
REPO1	HOST1	VM	N/A	N/A	N/A
SEAL MNGMT DBSVR	HOST05	VM	N/A	N/A	N/A
SEAL MNGMT SYS-APP01	HOST05	VM	N/A	N/A	N/A
TAA TRAINING 1	HOST05	VM	N/A	N/A	N/A
TEMAECASH	ECASHHOST	VM	N/A	N/A	N/A
Servers at Head Office, Regional and District Office					
HO - HP Proliant DL380 G5	N/A	PS	N/A	N/A	SUN Accounting
Accra West - Dell PowerEdge T110 II	N/A	PS	N/A	N/A	DC
Accra West - HP Pro 3500	N/A	PS	N/A	N/A	Kaspersky Server
Accra West - Dell OptiPlex 380	N/A	PS	N/A	N/A	DC
Accra West - HP Pro 3500	N/A	PS	N/A	N/A	Kaspersky Server

Hostname	Asset Tag or Host Server	Type	IP Address	OS	Purpose
Accra West - Dell OptiPlex 380	N/A	PS	N/A	N/A	SUN Accounting
Accra West - Dell PowerEdge T110	N/A	PS	N/A	N/A	Ecash Prepayment Server
Accra West - Dell PowerEdge R720	N/A	PS	N/A	N/A	DC
Ashanti E - HP Pro 3500	N/A	PS	N/A	N/A	Kaspersky Server
Ashanti E - Dell OptiPlex 380	N/A	PS	N/A	N/A	PPMS DC
Ashanti E - Dell OptiPlex 380	N/A	PS	N/A	N/A	Kaspersky Server
Ashanti W - HP Pro 3330 MT	N/A	PS	N/A	N/A	SUN Accounting (Old)
Ashanti W - Dell PowerEdge SC440	N/A	PS	N/A	N/A	PDSGH DC
Ashanti W - HP PRO 3500	N/A	PS	N/A	N/A	PPMS DC

Ashanti W - Dell PowerEdge T110	N/A	PS	N/A	N/A	Prepayment Server
Cape Coast - Dell PowerEdge	N/A	PS	N/A	N/A	DC
Central - HP Pro 3500	N/A	PS	N/A	N/A	SUN Accounting
Central - Dell PowerEdge T110	N/A	PS	N/A	N/A	Kaspersky Server
Central - Dell OptiPlex 380	N/A	PS	N/A	N/A	Cape Coast Prepayment Server
Central - Dell PowerEdge R710	N/A	PS	N/A	N/A	Kasoa Ecash Prepayment Server
Central - Dell PowerEdge T320	N/A	PS	N/A	N/A	Swedru Ecash Prepayment Server
Central - Dell PowerEdge R720	N/A	PS	N/A	N/A	Winneba Ecash Prepayment Server
Central - Dell PowerEdge R710	N/A	PS	N/A	N/A	DC
Central - Dell PowerEdge R710	N/A	PS	N/A	N/A	DC (RO)
Eastern - HP Pro 3500	N/A	PS	N/A	N/A	SUN Accounting (RO)
Eastern - Dell PowerEdge SC440	N/A	PS	N/A	N/A	Kaspersky Server (Reg.)
Eastern - Dell OptiPlex 380	N/A	PS	N/A	N/A	Prepayment Server (Kdua)
Eastern - Dell PowerEdge R720	N/A	PS	N/A	N/A	Prepayment Server (Tafo)
Eastern - Dell OptiPlex 3020	N/A	PS	N/A	N/A	Prepayment Server (Nkawkaw)
Eastern - Dell PowerEdge R710	N/A	PS	N/A	N/A	SUN Accounting MS SQL
Tema - HP Pro	N/A	PS	N/A	N/A	DC
Tema - HP ProDesk 400 G1	N/A	PS	N/A	N/A	Kaspersky Server
Tema - Dell PowerEdge T110	N/A	PS	N/A	N/A	SUN Accounting
Tema - Dell PowerEdge SC440	N/A	PS	N/A	N/A	Prepayment Server
Tema - Dell PowerEdge SC440	N/A	PS	N/A	N/A	SUN Accounting
Volta - PowerEdge R710	N/A	PS	N/A	N/A	Prepayment Server (Ho)
Volta - PowerEdge R710	N/A	PS	N/A	N/A	Prepayment Server (Hohoe)
Volta - HP Pro3500 Series	N/A	PS	N/A	N/A	DC
Volta - HP Pro3500 Series	N/A	PS	N/A	N/A	Prepayment Server
Volta - Dell OptiPlex 380	N/A	PS	N/A	N/A	Kaspersky Server
Volta - HP ProLiant ML310eG8	N/A	PS	N/A	N/A	SUN Accounting
Western - HP Pro 3500	N/A	PS	N/A	N/A	DC
Western - Dell OptiPlex 380	N/A	PS	N/A	N/A	Kaspersky Server
Western - Dell PowerEdge T110 II	N/A	PS	N/A	N/A	SUN Accounting

8.7 Storage Infrastructure

The ICT BU explained that, except for the Indra InCMS system and the backup devices, no shared storage solutions are deployed at PDS and that all storage is locally attached to the

servers. However, no information was made available by the ICT BU in regard to the shared InCMS storage solution.

No storage diagram and narrative for the storage setup for each site/location and server / storage device was made available by the ICT BU.

Figure 27: Storage Diagram Not

available.

8.7.1 Storage Area Network (SAN)

As per the ICT BU, PDS does not use any SAN devices.

Table 106: NAS Devices

Asset Tag	Hostname	IP Address	Manufacturer / Model	Year	Location	Configuration
None						

8.7.2 Network Attached Storage (NAS)

PDS uses NAS devices from Synology for file serving and backup-to-disk functionality. No detailed information beyond was made available by the ICT BU. Furthermore, details regarding NAS devices deployed at Regional or District Offices are not available.

Table 107: NAS Devices

Asset Tag	Hostname	IP Address	Manufacturer / Model	Year	Location	Configuration
1919/STR/0001	N/A	N/A	Synology Rackstation	N/A	PO DC	N/A (e.g. RAID setup)
1919/STR/0002	N/A	N/A	Synology Rackstation	N/A	Legon DR Site	N/A
1919/STR/0003	N/A	N/A	Synology Diskstation	N/A	PO DC	N/A
1919/STR/0004	N/A	N/A	Synology Diskstation	N/A	PO DC	N/A

Table 108: NAS File Shares

Hostname	Share / LUN Name	Directory / Folder	Protocol	Purpose
N/A	N/A	N/A	N/A	N/A

8.7.3 Long-Term Storage

8.7.3.1 Backup Solutions

PDS uses a backup solution from NAKIVO Backup & Replication (https://www.nakivo.com/) and NAS devices from Synology for backup-to-disk functionality. No detailed information was made available by the ICT BU.

PDS does not have deployed any long-term backup devices, such as Tape Robots/Libraries.

8.7.3.2   Archive Solutions

Neither hierarchical storage management systems (HSM) nor any other long-term archiving solutions are deployed.

8.7.4   Cloud Storage

No cloud storage solutions are in use at PDS.

No information was made available whether access to cloud storage services is blocked on the firewalls and whether exemptions are permitted for some users of PDS.

8.8   Controls

The review included determines whether PDS has identified configuration and security threats to its server and storage devices.

The answers in below tables were provided by the ICT BU but could not be not validated against the actual status quo. An "empty" response stands for "Not applicable", and when no answer / information was provided, worst-case scenario is assumed.

Out of 36 controls, PDS does not comply or complies only partially with 18 controls.

Furthermore, it needs to be noted that some responses supplied by the ICT BU, such as for the questions 33 and 34, are not in line with other available information. It therefore can be reasonable assumed that the non-compliance ratio for the Virtualisation/Server/Storage controls is most likely higher than the above 50%.

Legend: | Compliant or Not Applicable | Partially Compliant | Not Compliant |

Table 109: Virtualisation/Server/Storage Controls Questionnaire

ID	Question	Response	Comments
1	Are Installation Protocols for server/storage components, OSs and applications documented?	*No*	
2	Are all Servers and Storage components (devices) labelled with the Asset Tag (ID)?	*Partial*	*Some labelled, providing rolebased info*
3	Do the Disks in a Server have standardised Drive names (e.g. C drive named SRV01-OS)?	*No*	
4	Are all OSs regularly updated (patched)?	*Yes*	
5	If yes, frequency?	*Weekly*	*Sometimes delayed or skipped*
6	If yes, are the updates tested prior deployment?	*No*	

7	If yes, which patch categories are deployed (critical, security, other, all)	*Partial*	*Critical/Security*
8	Do devices have aliases defined in DNS (e.g. PDSSRV00001 = PDS-dc-01)	*Partial*	
9	Are computer descriptions defined for all devices (local and in AD)?	*No*	
10	Do the OS disks have redundancy (RAID)?	Yes	
11	If yes, which RAID type and how many disks are in the RAID?	*RAID1/5*	*Some RAID 1 others RAID 5*
12	Do servers have dedicated disks for the OS and application software (excl. application data)?	*Partial*	
13	Do servers have a dedicated swap /disk?	*No*	
14	Do servers have a dedicated disk for application data (excl. OS installation and application software installation)?	*Partial*	
15	Is remote access enabled on the servers?	Yes	
16	If yes, which one (e.g. RDP)?	*RDP*	
17	If yes, is access limited to certain IPs / subnets?	*No*	
18	Is IP v6 in use?	No	
19	If No, is IP v6 disabled on all devices?	*No*	
20	Do all devices have static IPs?	Yes	
21	Are the Default Gateway and multiple DNS servers configured?	Yes	
22	Is the primary DNS server setting on the Domain Controllers configured to point to a remote DNS server?	*No*	
23	Is reverse name resolution for all devices working (e.g. can you resolve the IP address of a device to its name)?	Yes	
24	Do servers use NIC teaming?	*Partial*	
25	If yes, specify which ones?	*InCMS, Holley servers*	*Pre-paid Meter systems*
26	Are VLANs configured on servers NICs?	*Partial*	
27	Are all device IPs documented in the IPAM?	Yes	*In Excel*
28	Are Regional Settings configured on all devices (e.g. Keyboard, Number, Currency, Date/Time, etc. formats, Location and Administrative settings)?	Yes	
29	Is the Time Zone on all devices configured (Ghana Time zone)?	Yes	
30	Are the standard local user accounts (Administrator, Guest, etc.) renamed or disabled?	*Partial*	*Guest yes, Admin no*
31	Are the device logs (Eventlogs) clear of errors?	*Partial*	
32	Have the warnings in the device logs (Eventlogs) been minimised?	*Partial*	*Randomly attending to it*

ID	Question	Response	Comments
33	Are all devices have Anti-Virus software installed?	*Yes*	
34	If yes, is the AV database and software up-to-date on all servers?	*Yes*	
ID	**Question**	**Response**	**Comments**
35	Are the SAN / NAS device storage areas been scanned regularly for viruses?	*Yes*	*Using dedicated AV software on NAS*
36	Are the latest Virtualisation tools installed on all VMs (if any)?	*Yes*	

Response: Yes, No, Partial, an "empty" cell (Not applicable) or "N/A" for information is not available

8.9   Virtualisation, Server and Storage – Planned Changes

Table 110: Virtualisation, Server and Storage – Planned Changes

Project	Timeline	Budget [US$]	Completed [%]
Data Centre & Communication Network (DCCN) – For details refer to Attachment **Error! Reference source not found.**	2019	N/A	5

9. Workstation and Peripheral Infrastructure

This section provides information on workstations and peripheral components. It covers the various devices' hardware, operating systems, desktop/application software and tools, as well as user data management and storage.

Neither has PDS a documented and approved IT procurement policy, nor has it regulated which type of equipment to procure.

9.1 Workstation Hardware and OS

The attachments listed in section **Error! Reference source not found.** contain the ICT w orkstation asset register of PDS in form of spreadsheets. The sheets vary in their format and quality (completeness / accuracy) of the data maintained therein (e.g. some sheets contain assets other than workstations). Substantial time needs to be invested to clean up, align and complete the registers before any further analysis of the data provided can take place.

Based on the available information it cannot be determined which and how many workstations are beyond life time (>= 5 years).

PDS has not standardised on any brand for its workstations and peripherals. There are many different models from various brands deployed at PDS.

According to the ICT BU more than 95% of PDS's workstations run as operating system a version of Windows (7, 8 or 10) that is still supported by Microsoft, and therefore no compatibility issues with the software currently installed are to be expected for those workstations. No information could be obtained what operating system the other workstations are running.

Table 111: Workstation Hardware & OS

Asset Tag / Hostname	Type	Manufacturer / Model	CPU	RAM [GB]	Disk [GB]	Year	OS	Count
See Attachments **Error! R eference source not found.**								

Type: PC=Desktop Computer, NB=Notebook/Laptop, WBT=Windows Based Terminal, LBT=Linux Based Terminal, CBT=Character Based Terminal

Table 112: Workstation Location & Connectivity

Location / Building / Floor / Office	AP / Access Switch	Asset Tag / Hostname	Connection
N/A			

Connection: UTP, Wireless, Fibre, VPN

9.2 Mobile Devices

Users are not allowed to access the Internet using their private devices. PDS has a captive portal implemented which requires domain credentials to successfully gain access to the Internet when using PDS ICT resources.

The ICT BU has no control over the procurement and deployment of mobile devices within PDS. Therefore, no further information was made available.

Table 113: Mobile Devices

Asset Tag / Hostname	Type	Manufacturer / Model	Year	OS	Location / Building / Floor / Office
N/A					

Type: PH = Phone, TA = Tablet

9.3 Peripherals

The ICT BU could not provide sufficient information regarding the IT peripherals deployed at PDS. Some information is contained in the supplied ICT asset registers listed under section **Error! Reference source not found.**.

Table 114: Peripheral Hardware

Asset Tag / Hostname	Type	Manufacturer / Model	Year	Business Unit	Location / Building / Floor / Office
N/A					

Type: PRN=Printer, SCA=Scanner, MFD=Multifunction Device (Printer, Scanner, Copier), PLT=Plotter, CDR=Cash Drawer, PRJ=Projector

9.4 Workstation Applications

9.4.1 Commercial Applications

PDS does not have any enterprise license agreements win place with any vendor. Typically, software for workstations (OS and applications) is procured bundled with a workstation.

The ICT BU did not provide any information regarding commercial workstation software deployed at PDS.

Manufacturer / Product	Version	Purpose	Installed	License Details
N/A				

Table 115: Workstation Commercial Software

9.4.2   Custom Developed Applications

The ICT BU did not provide any information or documentation regarding custom or inhouse developed workstation software deployed at PDS.

Table 116: Workstation Custom Developed Applications

Application Name	Version	Purpose	Business Units	Installed
N/A				

9.5   Workstation Storage Management

PDS makes storage locations available via network drives mounting shares on the Synology NAS devices at which users are supposed to store work related documents (for departments and teams).

PDS neither has a policy in place nor implemented that prevents end-users from storing data outside approved storage locations.

ID	Question	Response	Comments
1	Is a hardware inventory system in use?	No	

| 2 | Is a software (license) inventory system in use? | No | |
| 3 | Is an automated OS installation / deployment solution in use? | No | |

Further, PDS does not use folder redirection for the "My Documents", "Desktop", and related folders.

Backups of Workstations do not take place.

Table 117: File Shares for Workstation Storage Management

Hostname	File Share	Drive	Purpose
N/A			

9.6   Controls

The review included determines whether PDS has identified configuration and management threats for its workstation and peripheral environment.

The answers in below tables were provided by the ICT BU but could not be not validated against the actual status quo. An "empty" response stands for "Not applicable", and when no answer / information was provided, worst-case scenario is assumed.

Out of 20 controls, PDS does not comply or complies only partially with 16 controls.

Legend:

Compliant or Not Applicable	Partially Compliant	Not Compliant

Table 118:   Workstation &
Peripherals Controls

ID	Question	Response	Comments
4	Is an automated software package installation / deployment solution in use?	No	
5	Is the installation / configuration process for workstations and peripherals (devices) process documented?	No	
6	If yes, is there a checklist that is being used by the technicians to install / configure devices?		
7	Is there a standardisation policy in place to minimise device manufactures and models that are deployed?	No	
8	Is it ensured that data generated by users are stored on centralised storage facilities (not on local drives)?	No	
9	If yes, where do users store their documents? (Provide Share names and mounted drive letter)		
10	If yes, do users have a dedicated home folder on a file server / NAS?		
11	Is folder redirection for "My Documents", "Desktop", etc. in place to let users store by default their documents on a central storage location?	No	
12	If no, is it ensured that local data is synchronised to a centralised storage facility or backed up regularly?	Yes	To Synology

13	Are users prevented from storing data on local drives, e.g. via GPOs?	*No*	
14	Is there a formal backup policy in place for workstations?	*Yes*	
15	If yes, is the policy implemented?	*No*	*Not enforced*
16	Are users allowed to use their own, private devices (BYOD) to access network resources?	*N/A*	
17	Are users allowed to access the Internet via the corporate network?	*Yes*	
18	If yes, how is that regulated (Policy? Managed?)		*Daily quota, some sites are blocked*
19	Do you have documented installation / configuration processes?	*No*	
20	If yes, provide copies of the process documentation		

Response: Yes, No, Partial, an "empty" cell (Not applicable) or "N/A" for information is not available

9.7 Workstation and Peripheral Infrastructure – Planned Changes

Table 119: Workstation & Peripheral Infrastructure – Planned Changes

Project	Timeline	Budget [US$]	Completed [%]
None			

10. Annexures

10.1   The DCCN Project[4]

The deliverables of the DCCN (Data Centre & Communications Network) Project have an impact on the ERP Project in terms of the infrastructure that is required to implement and operate successfully the future ERP system of PDS. The DCCN Project targets upgrades of the existing infrastructure affecting the facilities (power supply, HVAC, etc.), the Wide Area Network infrastructure, the core Local Area Networks, and the virtualisation, server and storage environment at the three main data centres (Project Office, Legon and Kumasi).

MiDA contracted an individual consultant to undertake an assessment of PDS's existing ICT facilities including Data Centres and the associated PDS Communication Network, collectively referred to as the DCCN. Thereafter, the consultant developed designs for upgrading the DCCN facilities and infrastructure in order to enable support of PDS's current ICT environment and accommodate future deployment of new information systems that will enhance PDS's operational, maintenance, and commercial capabilities in connection with PDS's distribution network.

While PDS is the beneficiary, MiDA is the accountable entity responsible for managing and delivering the project in collaboration with its consultants and PDS personnel. The supplier shall work under close supervision of MiDA.

An Invitation for Bids (IFB) has been compiled by MiDA that relates to the provision of the DCCN upgrade and extension works. MiDA has published the IFB on the 19th November 2018 to engage suppliers to upgrade the existing DCs and communication network and put in service a new DR site in order to provide high availability of services and business continuity through network resiliency and compute and storage redundancy across the different computing sites of PDS. It is intended that the functional DC at PDS Projects Office will continue to be the primary DC and the secondary DC at East Legon will be the second DC.

The main goal of the DCCN Project is to provide a state-of-the-art ICT infrastructure capable of hosting business applications necessary for PDS's efficient production, distribution of power and the management of its services delivery to its customers. Such applications include, inter alia, GIS, ERP, ADMS and MMS. PDS is presently operating a primary DC with a backup DC and a disaster recovery site that just finishes building. The primary DC ensures the hosting of PDS's present application with limitation for growth and high availability. Hence the objective of this project will be met by upgrading the existing infrastructure for greater availability of services through resiliency and redundancy across the different computer sites through a robust communication network. The objectives of this IFB are to:

- Upgrade the HVAC and power systems of the existing DCs as required to support the additional ICT infrastructure provided under this contract.

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[4] The summarised write-up in this section sourced from the IFB named Procurement of Upgrade of the Electricity Company of Ghana Limited (PDS) Data Centre & Communication Network, CB No: 5120400-01/IFB/CB/11/18.

- New HVAC and power system of the new DR room in Kumasi.

- Upgrade and Installation of additional ICT infrastructure at the existing DC sites.

- Installation of new ICT at the DR site.

- Upgrade of the communication network for greater WAN capacity and the enablement of advanced WAN services such as VoIP and QoS for services such as VoIP and SCADA.

10.2   Site Visits Overview

In order to obtain a representative picture of the status of PDS's IT environment in respect to facilities, network, servers and end-user computing, 19 of the 92 PDS offices (list provided by PDS) were visited as listed below.

Table 120: Site Visits – General Information

Region – Office	Visit	Buildings	Contact
Special Offices			
Accra – Head Office	20/11/18	5	ICT Directorate, Infrastructure
Accra – Project Office	20/11/18	1	ICT Directorate, Infrastructure
Accra – DR Site @ Legon	15/10/18	5	ICT Directorate, Infrastructure
Regional Offices			
Accra West – Kaneshie	15/10/18	2	Regional ICT Sandra Luvina Atsu (Martin & Yaw)
Ashanti – Kumasi	17/10/18	1	Regional ICT Manager Dakwa (Deputy Michael)
Central – Cape Coast	16/10/18	2	Regional ICT Manager Gabriel
Eastern – Koforidua	19/10/18	3	Regional ICT Manager Stephen
Volta – Ho	22/10/18	4	Regional ICT Manager Tribune Olokemor
Western – Takoradi	16/10/18	2	Regional ICT Manager Robert / Eron
District Offices			
Accra East – Kwabenya	15/10/18	2	District Commercial Officer
Accra West – Kaneshie	15/10/18	2	District Commercial Officer
Ashanti – Mampong	18/10/18	3	District Commercial Officer, Alexander Dzakah
Central – Kasoa North	16/10/18	1	District Commercial Officer, Reggie
Eastern – Donkorkrom	18/10/18	1	District Commercial Officer, Dennis (Acting)
Eastern – Nkawkaw	19/10/18	3	District Commercial Officer, Solomon
Volta – Dambai	23/10/18	1	District Commercial Officer
Volta – Hohoe	22/10/18	5	District Manager, Stephen
Western – Bibiani	17/10/18	2	District Manager, George
Western – Sekondi	16/10/18	1	District Manager, George

Table 121: Site Visits – Notes

Region – Office	Notes

Special Locations	
Accra – Head Office	Electro Volta House, Server Room on 4th floor
Accra – Project Office	Main Data Centre, Three Server Rooms in other building
Accra – DR Site @ Legon	Accra East, DC on 1st floor
Regional Offices	
Accra West - Kaneshie	Main & Warehouse buildings
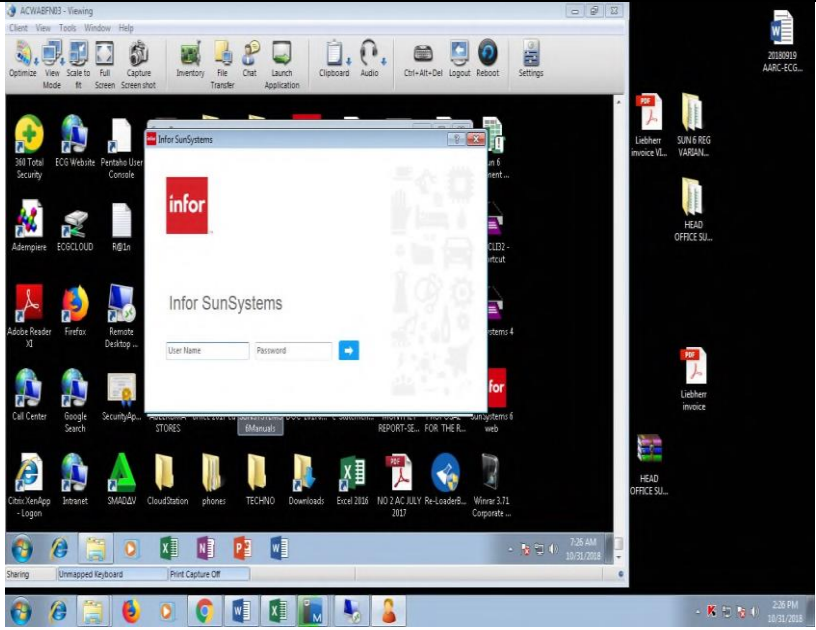
Region – Office	Notes
	Building relatively new (~ 3 years), DC on 3rd floor Three (3) IT staff members for region Ethernet link to district office Kaneshie (distance ~ 100m)
Ashanti – Kumasi	Main Building Network Room on 1st Floor (will stay) Server Room on 2nd floor (will move to new DC room) Nine (9) IT staff members for region
Central – Cape Coast	Main Building (under renovation, will be re-cabled) & Warehouse Server Room on 1st floor Four (4) IT staff members for region
Eastern – Koforidua	Main, Cash Point & Security Server Room on Ground Floor, Main Building (Cabling of Cash Point goes to Main) Four (4) IT staff members for region
Volta – Ho	Main, Stores, Workshop, District Office (old Reginal Office) Three (3) IT staff members for region Network unstable due to poor WAN links
Western – Takoradi	Main & Stores building Server Room on 1st floor, second Server Room on Ground Floor Six (6) IT staff members for region Substantial damage over weekend due to lightning strike
District Offices	
Accra East – Kwabenya	Main & Substation building Server Room on 1st floor
Accra West – Kaneshie	Main & Customer Service building Server Room on 1st floor
Ashanti – Mampong	DCO, DTO & Warehouse buildings Server/Network facilities in office of DCO building
Central – Kasoa North	Main building
Eastern – Donkorkrom	Main building
Eastern – Nkawkaw	Main & 2 old office blocks (no network)
Volta – Dambai	Main building Unstable network
Volta – Hohoe	New building (under construction), old temp. building (as office block), Warehouse (under construction), Substation & Workshop IT shall take advantage of new office block to install right devices
Western – Bibiani	Main & Conference Room (under construction)
Western – Sekondi	Main (new office under construction)

10.3 Details of Business Applications

The details provided in this Annexure has been provided by the ICT BU by completing a questionnaire for each application. For some applications (no table in the respective section, the ICT BU did not provide any information).

10.3.1 Infor SunSystems

Table 122: Information System Details – Infor SunSystems

Information Requested	Response
General Information	
Application Name	Infor SunSystems
Vendor	Infor Global Solutions
Version	Version 6.2.1
Website (URL)	https://www.infor.com/products/sunsystems
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	PDS uses SunSystems 6, Infor Query and Analysis for processing financial data and generating financial reports
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Fixed Assets Ledger Accounting Purchasing Invoice Inventory Control Infor Query and Analysis
ERP Relevant? (Yes/No)	Yes
Business Systems	
Business Owner (Custodian) – Contact Details	Infor Global Solutions Email: Mobile: 646-336-1700 Office: Infor, 641 Avenue of the Americas, New York, NY 10011, USA
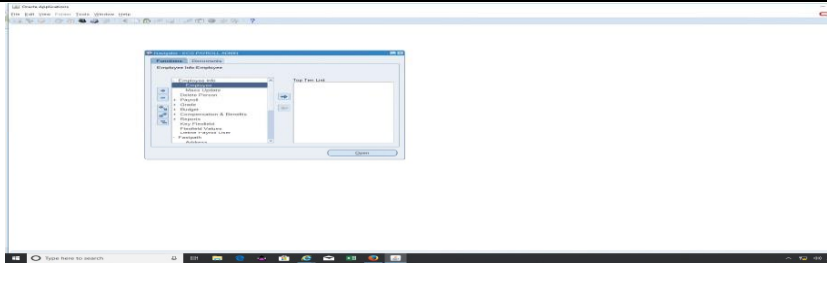
Information Requested	Response
ICT Support Staff – Contact Details	Theobald Owusu-Ansah Position: Assistant Accounting Officer/ SunSystems Administrator Email: towusu-ansah@PDSgh.com Mobile: 020-8269214 Office: P. O. Box GP 21325 Accra
License Agreement	Yes, there is license Agreement
Support / Maintenance Agreement	The systems is supported by internal SunSystems Administrators and Systems Accountants, but maintenance is done by external consultant which is Electronic Merchant Systems (Infor Global Solution channel partners)
Business Units using the system (which modules) and Number of Users	**Ledger Accounting:** PDS Head Office, Project Office, Accra East, Central Region, Volta Region, Eastern Region, Western Region, Tema Region, Tema Materials and PDS District offices **Purchase Invoice:** PDS Head Office and Tema Materials **Fixed Assets:** PDS Head Office **Inventory:** Project Office, Accra East, Central Region, Volta Region, Eastern Region, Western Region, Tema Region, Tema Materials and All PDS District offices **Infor Query and Analysis:** PDS Head Office, Project Office, Accra East, Central Region, Volta Region, Eastern Region, Western Region, Tema Region, Tema Materials and PDS District offices Infor Query and Analysis Users: **105** Ledger Accounting, Purchase Invoice, Fixed Assets, Inventory Users: **105**
Locations where use Name offices where Application is accessed	PDS Head Office, Project Office, Accra East, Central Region, Volta Region, Eastern Region, Western Region, Tema Region, Tema Materials and PDS District offices
Perception of user community	Good
Data Input What info is fed into the system?	All financial transactions and management accounting transactions
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Over 30 000 records a day
Master Data used by system Which system is custodian of master data?	Chart of Accounts Item Records Analysis Journal Definition Report Definition Custodian: Infor Global Solutions
Data Output (what info is delivered)	Financial Management Report and Ad-hoc report
Frequency of Data Output	Daily
What is the Data Output used for	Financial Reporting
Interfaces (input / output)	Manuel, Excel files and xml files
Integration with other systems	InCMS, Oracle Human Resources and Payroll Management and Oracle Assets Management
Technical Information	

Server(s) Server Names, IP Addresses, Location, OS	Name	IP Address	Location	Op. System
	PDSSUNSVER		Proj. Office DC	Win Srv 2012 R2
	PDSSUNSVER2		Proj. Office DC	Win Srv 2012 R2

Purpose of Servers	The server runs Oracle software and handles the functions required for concurrent, shared data access. The server receives and processes the SQL and PL/SQL statements that originate from client applications.

Database System	Name	Vendor	Version	
	MySQL	Oracle	12.0.20	

Workstation Software	Name	Version	
	SunSystems 6 Thick Client	6.2.1	
	Infor Query and Analysis	10.1.8	

10.3.2 Oracle E-Business and BI Suites

10.3.2.1 Oracle HCM Payroll

Table 123: Information System Details – Oracle HCM Payroll

Information Requested	Response
General Information	
Application Name	Oracle E-Business Suite
Vendor	Oracle/ Pro Vision Consultants ltd
Version	12.1.3
Website (URL)	https://www.oracle.com
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	The Oracle E-Business Suite delivers Oracle's market-leading database and application server products in a single, consolidated technology stack. Featuring tight integration with Oracle's infrastructure management tools such as Oracle Enterprise Manager 10*g* Grid Control, the Oracle E-Business Suite offers enterprise-class scalability, performance, and high-availability, reducing the Total Cost of Ownership for enterprises of all sizes.
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Payroll, Human Resources, Enterprise Performance Foundation
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Director of Finance Position: Director of Finance Email: Office: Electro- Volta House P.O. Box 521, Accra
ICT Support Staff – Contact Details	1.Mr. Crown Disu Position: Analyst Programmer Email:cdisu@PDSgh.com Office: Projects Office P.O. Box AN 5278, Accra Office 2.Mrs Afua Annan Position: Analyst Programmer Email:aannan@PDSgh.com Office: Projects Office P.O. Box AN 5278, Accra Office
License Agreement	

Support / Maintenance Agreement	There is maintenance agreement with ProVision Consultants Ltd. Address: Near Energy Foundation Okponglo. Accra Email: apokoo@provision-consultants.com Tel: 0302513815
Business Units using the system (which modules) and Number of Users	Human Resource, Finance Users:113

Information Requested	Response			
Locations where use Name offices where Application is accessed	Head Office, Heritage Towers, Regional Offices, District Offices			
Perception of user community	Ok			
Data Input What info is fed into the system	Personal details of employees, employee upgrade, change of banks, credit union and welfare enrolments			
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Monthly pay runs for over 6,000 staff			
Master Data used by system Which system is custodian of master data?	Same system			
Data Output (what info is delivered)	PaySlip of employees			
Frequency of Data Output	Monthly			
What is the Data Output used for	Pay salary of employees			
Interfaces (input / output)	Employee details, bank details, Employee Payslip			
Integration with other systems				
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	ebsprod		Data Centre, Projects Office	UNIX AIX version 7.1
	ebsdev		Data Centre, Projects Office	UNIX AIX version 7.1
Purpose of Servers	The server runs Oracle software and handles the functions required for concurrent, shared data access. The server receives and processes the SQL and PL/SQL statements that originate from client applications.			
Database System	**Name**	**Vendor**	**Version**	
	Oracle	Oracle/ProVision consultants ltd	11.2.0.4.0	
Workstation Software	**Name**		**Version**	
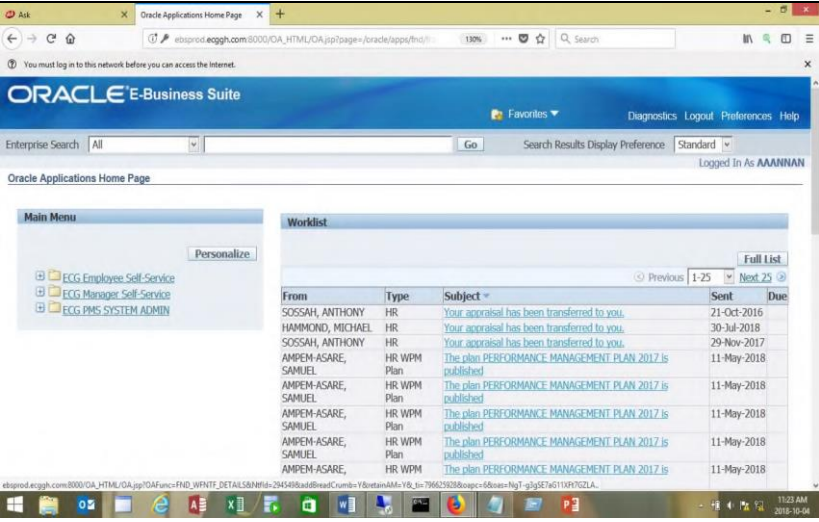
10.3.2.2 Oracle Performance Management System (PMS)

Table 124: Information System Details – Oracle Performance Management System (PMS)

Information Requested	Response
General Information	
Application Name	Performance Management System (PMS)

Vendor	Oracle
Version	11.2.0.4. 0
Website (URL)	https://www.oracle.com/applications/ebusiness/ https://ebsprod.PDSgh.com:8000/
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	It enables staff set their objectives and targets for the year
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Payroll, Performance and Human Resource
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Performance Management System = Human Resource Payroll = Finance
ICT Support Staff – Contact Details	Mr. Crown Disu Position: Analyst Programmer Email: cdisui@PDSgh.com Office: Projects Office P.O. Box AN 5278, Accra Office Mrs. Afua Abrafi Annan Position: Analyst Programmer Email: aaannan@PDSgh.com Office: Projects Office P.O. Box AN 5278, Accra Office
License Agreement	Yes
Support / Maintenance Agreement	Yes
Business Units using the system (which modules) and Number of Users	Finance Module User: Finance Directorate Performance Module User: All Directorates

Information Requested	Response

Locations where use Name offices where Application is accessed	Project Office All PDS Offices: Head office Project office Training school All substations All regions All districts			
Perception of user community	Good			
Data Input What info is fed into the system	Objectives of staff Targets Scores achieve over the period			
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Quarterly			
Master Data used by system Which system is custodian of master data?	N/A			
Data Output (what info is delivered)	Scores per staff			
Frequency of Data Output	Every six (6) months			
What is the Data Output used for	To ascertain the performance of staff			
Interfaces (input / output)				
Integration with other systems	N/A			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	ORACLE PAYROLL		Data Centre – Project Office	Linux
Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose			
Database System	**Name**	**Vendor**	**Version**	
	ORACLE 11g	ORACLE	11.2.0.4.0	
Workstation Software	**Name**		**Version**	

10.3.2.3 Oracle Balanced Scorecard (BSC)

Table 125: Information System Details – Oracle Balanced Scorecard (BSC)

Information Requested	**Response**
General Information	
Application Name	Balanced Scorecard (BSC)
Vendor	Oracle
Version	End of Live announced by Oracle. Replaced by "Oracle Scorecard and Strategy Management"
Website (URL)	https://www.oracle.com/applications/ebusiness/

Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	A strategic planner and management system that PDS uses to prioritise projects, measure and monitor progress towards strategic targets and communicate what it tries to accomplish.
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Balanced Score Card
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Director of Cooperate Services
ICT Support Staff – Contact Details	Awuviri Husseine Emmanuel Owusu Joshua Bonsu Anthony Addo-Teye
License Agreement	Yes
Support / Maintenance Agreement	Yes
Business Units using the system (which modules) and Number of Users	FINANCE HUMAN RESOURCES CUSTOMER SERVICE OPERATIONS ENGINEERING NETWORK PROJECTS ICT MATERIALS AND TRANSPORT PROCUREMENT PREMISES AND ESTATE AUDIT LEGAL MD OFFICE CORPORATE PLANNING ACCRA EAST ACCRA WEST TEMA VOLTA EASTERN ASHANTI SBU WESTERN CENTRAL SUB-TRANSMISSION TRAINING SCHOOL
Locations where use Name offices where Application is accessed	Head Office Project Office All Regional offices

Information Requested	Response
Perception of user community	Good
Data Input What info is fed into the system	Objectives of the Directorate/Region Key Performance Indicators for each Directorate/Region Initiatives Actual and Targeted performance

Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Monthly			
Master Data used by system Which system is custodian of master data?	Custodian = Same System			
Data Output (what info is delivered)	Performance reports			
Frequency of Data Output	Daily			
What is the Data Output used for	Monitoring and Evaluation			
Interfaces (input / output)				
Integration with other systems	Adempiere InCMS iTop			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose			
Database System	**Name**	**Vendor**		**Version**
Workstation Software	**Name**		**Version**	

10.3.3 ADempiere ERP & InCMS (Material Management)

Table 126: Information System Details – ADempiere ERP & CRM (Material Management)

Information Requested	Response
General Information	
Application Name	ADempiere ERP & InCMS – Only Materials Management module in use
Vendor	ADempiere
Version	3.6.0LTS + P20101015
Website (URL)	http://www.adempiere.net
Documentation (if no website provided, attach documentation and provide filenames)	http://www.adempiere.net/web/guest/wiki
Description / Purpose (short overview)	The ADempiere is a materials management software that manages the requisitioning, distribution and management of all PDS Materials.

Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Materials Module Engineers Module Estimators Module Transport Requisition Accounts Module
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Director of Material and Transport Office: Projects Office P.O. Box AN 5278, Accra Office
ICT Support Staff – Contact Details	Mr. Adrian Mends Position: ICT Officer Email: amends@PDSgh.com Mobile: Office: Projects Office P.O. Box AN 5278, Accra Office
License Agreement	Open Source
Support / Maintenance Agreement	Internal
Business Units using the system (which modules) and Number of Users	Materials and transport, Engineers, Customer Service and Accounts Users = 2773 as at 10/10/2018

Information Requested	Response
Locations where use Name offices where Application is accessed	Head Office, Tema Depot, Projects Office, Accra East Regional Office, Legon, Roman Ridge, Kwabenya, Mampong Akwapim, Teshie, Makola, Dodowa, Accra West Regional Office, Achimota, Korle Bu, Nsawam, Dansoman, Bortianor, Kaneshie, Ablekuma, Tema Regional Office, Nungua, Manhean, Krobo, Prampram, Kwablagon, Ada, Afienya, Tema South, Central Regional Office, Kasoa, Assin Fosu, Saltpond, Adjumako, Bremang Asikuma, Agona, Winneba, Cape Coast, Twifo Praso, Western Regional Office, Bibiano, Sefwo, Juaboso-bia, Encni, Asankragua, Tarkwa, Axim, Takordi, Sekondi, Half Assini, Bogoso, Agona, Ashanti SBU Regional Office, Obuasi, Offinso, Bekwai, Dunkwa, Suame, Danyame, Abuakwa, New Edubiase, Konongo, Effiduase, Mampong, Asokwa, Manhyia, Ayigya, Kwabre, Volta Regional Office, Akatsi, Keta, Ho, Jasikan, Nkwanta, Dambai, Hohoe, Sogokope, Kpevep, Denu, Kpando, Eastern Regional Office, Donkokrom, Mpreaso, Tafo, Koforidua, Suhum, Kibi, Akwatia, Asamankese, Akim Oda, New Abirim, Nkawkaw, Asesewa, Begoro, Kade, Sub Transmission
Perception of user community	Network availability is a problem, Uncompleted functionality
Data Input What info is fed into the system	Material information, Engineers Material Estimator information

Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Daily Material Requisitioning 300/day Stores Receipt 500/Month Capital Jobs(Regions & Districts) 600/Month New Service Connection Request from InCMS 11,700/Month
Master Data used by system Which system is custodian of master data?	Local (Same system), materials pricing data is mastered in SUN accounting system, Staff data is mastered in HR/Payroll system
Data Output (what info is delivered)	Materials schedule for Jobs exported as CVS to InCMS, materials consumption, balances All reports can be extracted to excel
Frequency of Data Output	Daily
What is the Data Output used for	What are the reports used for
Interfaces (input / output)	CSV Text files (ftp), and web services
Integration with other systems	Commercial Management Software (InCMS)
Technical Information	

	Name	IP Address	Location	Op. System	
Server(s) Server Names, IP Addresses, Location, OS	ADempiere Application		Projects Office	Linux	
	Database		Projects Office	Linux	
Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose				

	Name	Vendor	Version	
Database System	Oracle	Oracle	11g	

	Name	Version	
Workstation Software	Windows	XP,Windows 10	

10.3.4   Indra InCMS

Table 127: Information System Details – Indra InCMS

Information Requested	Response
General Information	
Application Name	InCMS
Vendor	Indra
Version	v18.07.13
Website (URL)	
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	Indra Commercial Management System (InCMS): A commercial management system which serves as a platform for all commercial activities in PDS. From Contracting to Billing, meter management, a repository of all prepayment and payment data. Reading of meters, to customer contact

Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Billing Contracting Payment Reading Contacts Module Meter Management
ERP Relevant? (Yes/No)	Answer: **Yes**, The Application interfaces with all prepaid systems and ADempiere a materials management system. Hence it is a repository of data and will in some way exchange data with the ERP
Business Information	
Business Owner (Custodian) – Contact Details	Director of Customer Service
ICT Support Staff – Contact Details	Awuviri Husseine Emmanuel Owusu Emmanuel Awuah Crown Disu Afua Annan Benjamin Novihoho, Bennette Amoah Anthony Addo-Teye
License Agreement	Yes, License Available
Support / Maintenance Agreement	Yes, Maintenance Agreement Available
Business Units using the system (which modules) <u>and</u> Number of Users	Customer service Finance Materials and transport

Information Requested	Response
Locations where use Name offices where Application is accessed	All Regions and Districts
Perception of user community	Bad
Data Input What info is fed into the system	Readings Prepayment systems data Payments, Customer information

Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Payment Transaction per day=20702 Number of Users=3570 Number of Billing transaction=52282 Daily customer setup=1800
Master Data used by system Which system is custodian of master data?	Custodian = Same
Data Output (what info is delivered)	Reports
Frequency of Data Output	Daily
What is the Data Output used for	Native reports Feeds into Pentaho
Interfaces (input / output)	Adempire
Integration with other systems	Adempiere E-Cash 1,2,3 PNS PNS Smart SmartG SmartCash BXC SmartCash BOT EnerSmart Liberty MBH Clou L&R Clou IMES Kampstrut

Technical Information				

Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	Production		Project Office	
	Disaster Recovery		Legon (DR)	
	Production		Project Office	Xen Server
	Disaster Recovery		Project Office	Xen Server
			Legon (DR)	Xen Server

Information Requested	**Response**

Purpose of Servers – Flow diagram (1)	Provide data flow diagram how servers interact plus short description of server purpose

Purpose of Servers – Flow diagram (2)	
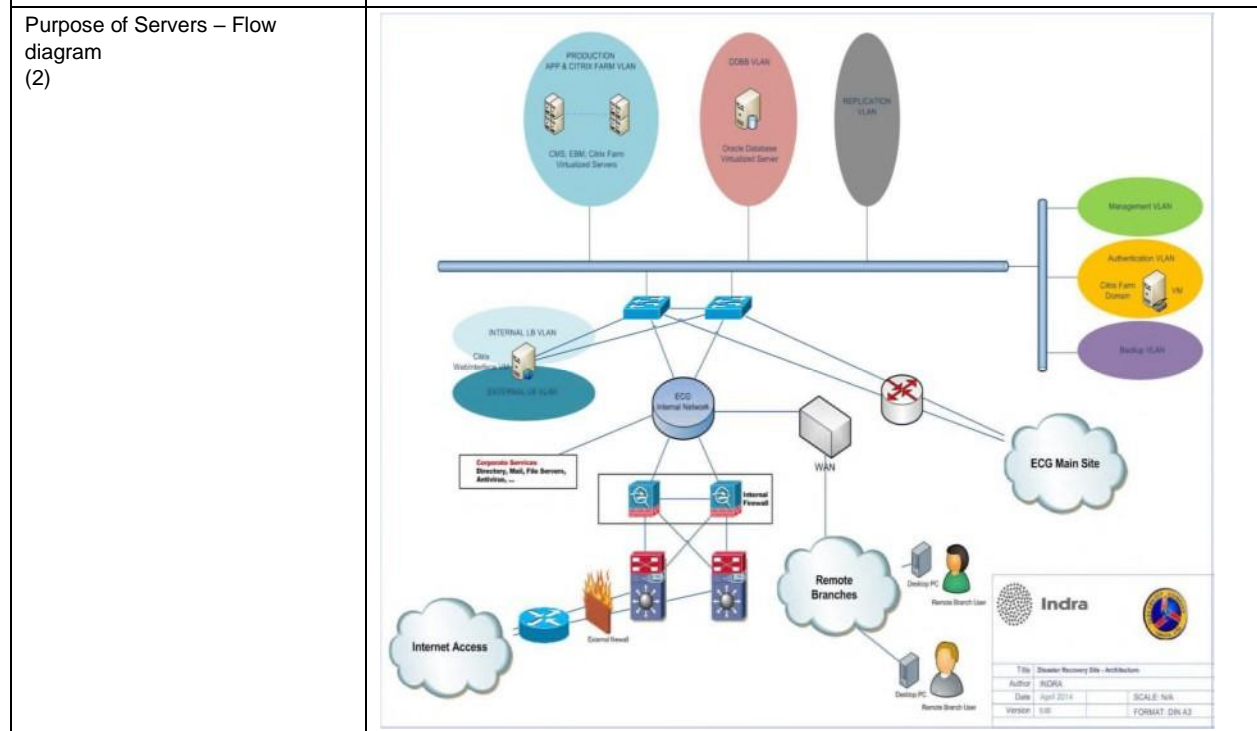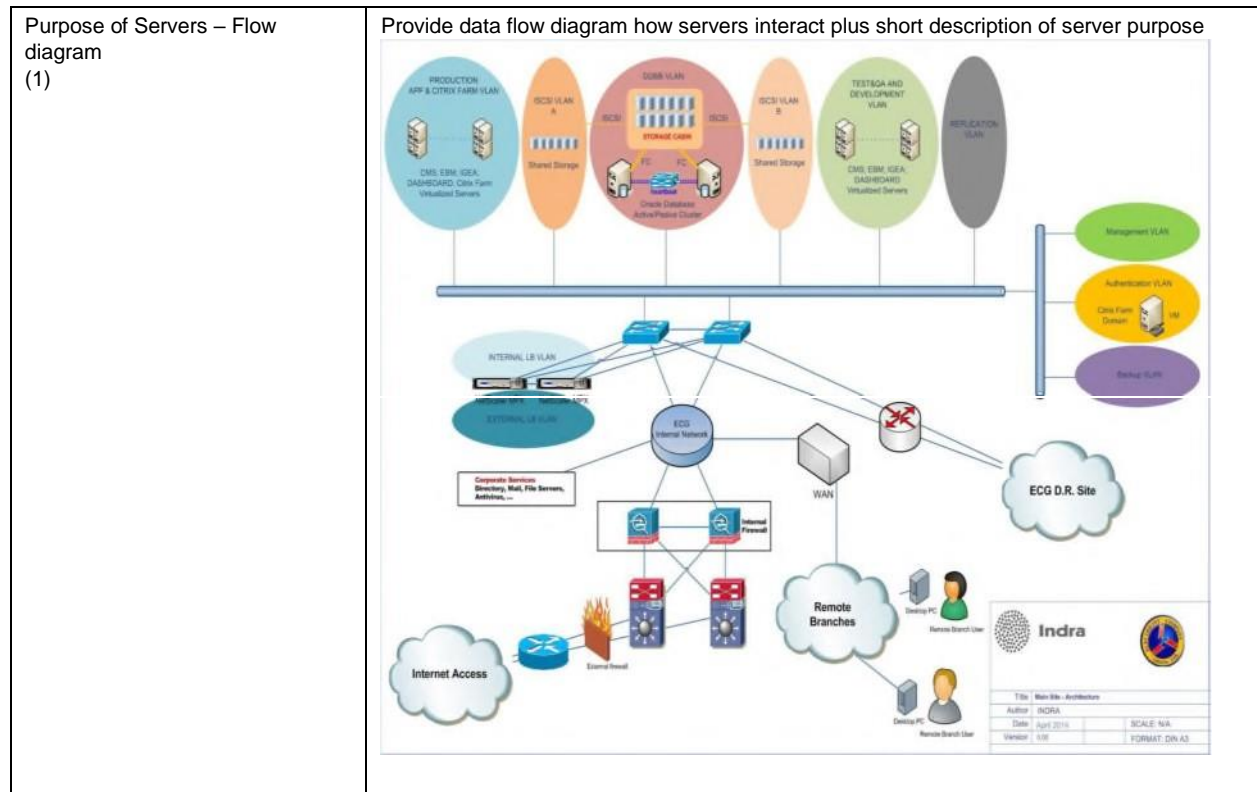
Database System	Name	Vendor	Version
		Oracle	(11.2.0.4.0)
		Oracle	(11.2.0.4.0)

Workstation Software	Name		Version
	Citrix		6.2

10.3.5   Hitachi Pentaho

Table 128: Information System Details – Hitachi Pentaho

Information Requested	Response			
General Information				
Application Name	Pentaho			
Vendor	Pentaho Corporation			
Version	5.4.0.1.130			
Website (URL)	www.pentaho.com			
Documentation (if no website provided, attach documentation and provide filenames)	N/A			
Description / Purpose (short overview)	Pentaho is a business intelligence (BI) software that provides data integration, OLAP services, reporting, information dashboards, data mining and extract, transform, load (ETL) capabilities. Refer to https://www.hitachivantara.com for more information.			
Screenshot of Home Screen/Page (first screen that pops up after login)	N/A			
Modules in use	Reporting			
ERP Relevant? (Yes/No)	Yes			
Business Information				
Business Owner (Custodian) – Contact Details	Director of Customer Service			
ICT Support Staff – Contact Details	Edward Osei Tawiah			
License Agreement	Yes			
Support / Maintenance Agreement	Yes			
Business Units using the system (which modules) and Number of Users	CSD Finance			
Locations where use Name offices where Application is accessed	All PDS district and Regional offices			
Perception of user community	N/A			
Data Input What info is fed into the system	N/A			
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	N/A			
Master Data used by system Which system is custodian of master data?	N/A			
Data Output (what info is delivered)	N/A			
Frequency of Data Output	N/A			
What is the Data Output used for	N/A			
Interfaces (input / output)	N/A			
Integration with other systems	N/A			
Technical Information				
Server(s)	**Name**	**IP Address**	**Location**	**Op. System**

Server Names, IP Addresses, Location, OS	N/A	10.17.101.34:8085	N/A	N/A
Purpose of Servers	N/A			

Information Requested	Response		
Database System	**Name**	**Vendor**	**Version**
	N/A	N/A	N/A
Workstation Software	**Name**		**Version**
	N/A		N/A

10.3.6 Pre-Paid Management Systems

10.3.6.1 BXC BOT

Table 129: Information System Details – BXC BOT

Information Requested	Response
General Information	
Application Name	BOT (Build Operate Transfer)
Vendor	BXC Ghana Ltd.
Version	9.4.0.2
Website (URL)	http://www.bxcghana.com
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Vending services Reporting Service
ERP Relevant? (Yes/No)	Yes
Business In formation	
Business Owner (Custodian) – Contact Details	Bxcghana Ltd. Director of Customer Service
ICT Support Staff – Contact Details	Afua Asomaning Sakyi 0246664089 Emmanuel Owusu 0249375590
License Agreement	
Support / Maintenance Agreement	
Business Units using the system (which modules) and Number of Users	Customer Service Directorate (CSD) 609 users as at 10/10/2018 Number of payment transaction = 1,800
Locations where use Name offices where Application is accessed	1. Dansoman 2. Kaneshie 3. Achimota 4. Korle Bu
Perception of user community	Good
Data Input What info is fed into the system	Purchasing Amount

Frequency of Data Input Transaction volume per dataset (e.g. new connections)	18,000 records per day
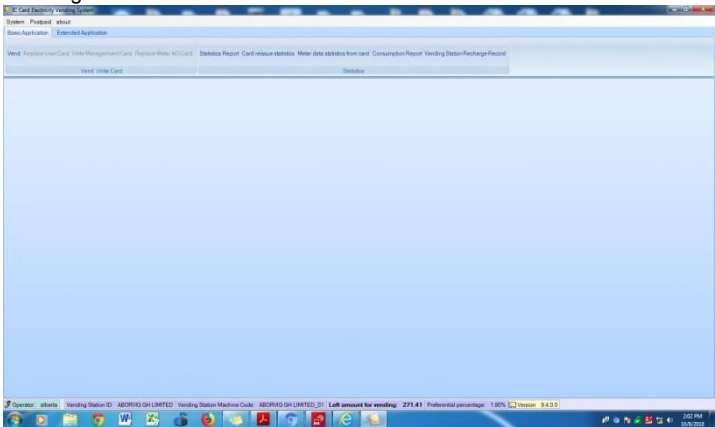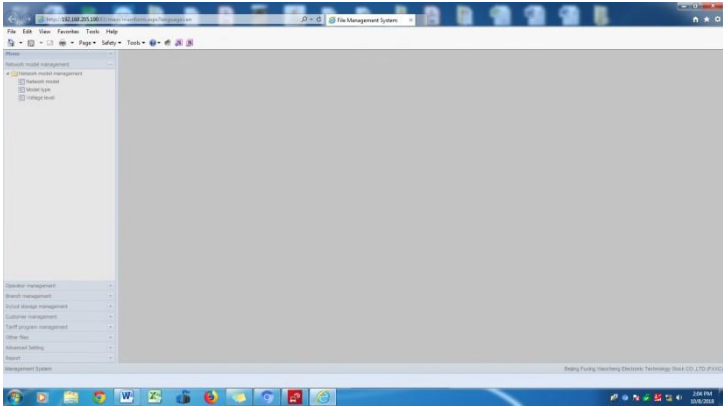
Information Requested	Response			
Master Data used by system Which system is custodian of master data?	Custodian: InCMS			
Data Output (what info is delivered)	Sales Report			
Frequency of Data Output	Daily			
What is the Data Output used for	Sales Report			
Interfaces (input / output)				
Integration with other systems	InCMS			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	BOT SERVER		Projects office	WINDOWS 7
	BACKUP		Projects office	
Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose			
Database System	**Name**	**Vendor**		**Version**
	ORACLE	ORACLE		9i
Workstation Software	**Name**		**Version**	

10.3.6.2 BXC BXC
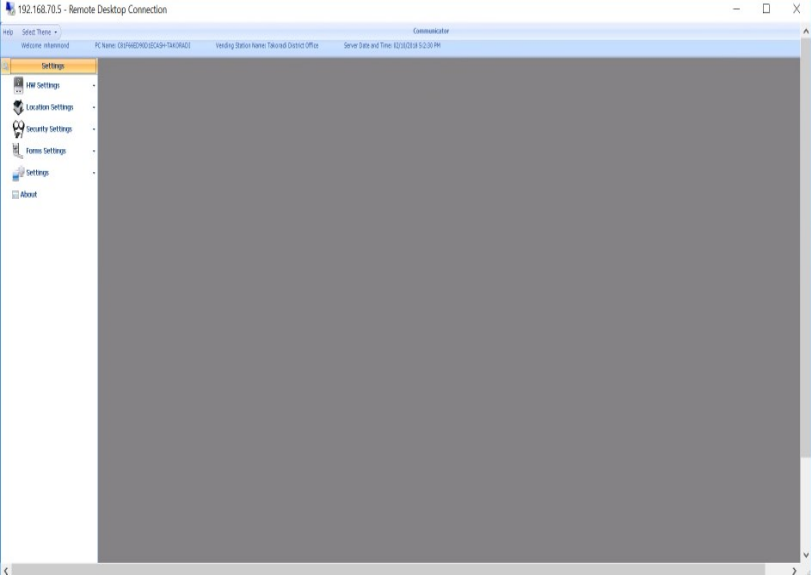
Table 130: Information System Details – BXC BXC

Information Requested	Response
General Information	
Application Name	BXC
Vendor	BXC
Version	File Management 1.0; SELL Electric Software 9.5.0.2
Website (URL)	http://www.bxcghana.com
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	Client Server System for Meter Management and Vending Functions
Screenshot of Home Screen/Page (first screen that pops up after login)	Vending module File management (Meter and customer management module)
Modules in use	Vending Module File Management Software (Meter and Customer management module) PLC Software (Communication module)
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Kevin Wu, Box CT 8365 Cantonments Accra Director of Customer Service

ICT Support Staff – Contact Details	Name: Mawusi Akasreku
	Position: Manager Infrastructure Support
	Email: makasreku@PDSgh.com
	Office Location: Projects Office

Information Requested	Response
License Agreement	No
Support / Maintenance Agreement	No
Business Units using the system (which modules) and Number of Users	Customer Services Directorate: Meter and Customer management module = 32 PLC Software (Communication module) = 25 Administrator = 4 Developers = 2 Finance: PDS Cashier = 39 Private vendors = 664 Total = 766 Users
Locations where use Name offices where Application is accessed	1. Teshie District 2. Bortianor District 3. Nungua District (BLK 010) 4. Ablekuma District 5. Nsawam District
Perception of user community	A Good Working Application (Good for revenue collection)
Data Input What info is fed into the system	Data on Meters; Customer Information; Vending Data; Transformer Information
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Average Daily Vending Transactions=17227 Average Daily Meter Setup=355 Total number of customer= 274531 as at 10-10-2018
Master Data used by system Which system is custodian of master data?	InCMS
Data Output (what info is delivered)	Sales Report; Consumption Report; Quota Sales Report; Vending Reports; Reports on Transformers
Frequency of Data Output	Daily; Weekly; Monthly; Query Data in Selected Periods
What is the Data Output used for	Management Decisions; Financial Analysis; Monitoring of Meters
Interfaces (input / output)	CSV Files; Automatic; User Interface
Integration with other systems	InCMS
Technical Information	

Information Requested	Response			
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	File Management and Sell Electricity		BXC OSU	Win Server 2012 r2
	NLocate Service Computer Power Service Load Power Service Save Power Service Task Service		BXC OSU	Win Server 2012 r2

	Oracle Main Service		BXC OSU	Win Server 2012 r2
	Oracle Standby Service		BXC OSU	Win Server 2012 r2
	InCMS-Oracle Service		BXC OSU	Win Server 2012 r2
	Host		Projects Office	Win Server 2012 r2
	Oracle Standby Service		Projects Office	Win Server 2012 r2
	Sell Electricity		Projects Office	Win Server 2012 r2
	Vodafone		BXC OSU	Win Server 2012 r2
	MTN		BXC OSU	Win Server 2012 r2
	MTN		BXC OSU	Win Server 2012 r2
	MTN		BXC OSU	Win Server 2012 r2

Purpose of Servers	

Database System	Name	Vendor	Version
	Oracle	Oracle	11.2.0.1

Workstation Software	Name	Version
	Vending Software	9.5.0.2
	File Management Software	1.0
	PLC Application	1.0

10.3.6.3 Ghana Electrometer e-Cash

Table 131: Information System Details – Ghana Electrometer e-Cash

Information Requested	Response
General Information	
Application Name	e-Cash
Vendor	Ghana Electrometer
Version	99

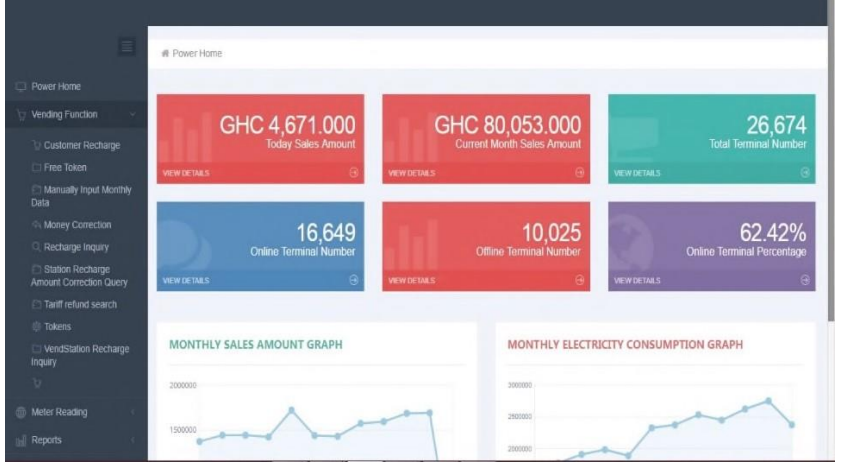|	
Website (URL)	http://electrometer.com.gh
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	It is a prepaid metering system that runs on SQLSERVER on Windows platform.
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	The Director of Customer Service, Electricity Company of Ghana
ICT Support Staff – Contact Details	Mr. Michael Hammond; Manager/Database Management Mobile: 0244267868
License Agreement	Yes
Support / Maintenance Agreement	Yes
Business Units using the system (which modules) and Number of Users	Finance, Customer Service
Locations where use Name offices where Application is accessed	All regions of PDS except Accra West and Ashanti SBU. Regions using E-Cash: Accra East, Central, Western, Volta, Eastern and Tema.
Perception of user community	Good
Data Input What info is fed into the system	Power Usage Details and Commercial Details of the Customer.
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Daily

Information Requested	Response
Master Data used by system Which system is custodian of master data?	Commercial Management System (InCMS)
Data Output (what info is delivered)	Sales Information, Billing Information, Power Usage and Customer Information
Frequency of Data Output	Daily

What is the Data Output used for	Reporting and Analysis for every district
Interfaces (input / output)	Input and Output
Integration with other systems	InCMS
Technical Information	

Server(s) Server Names, IP Addresses, Location, OS	Name	IP Address	Location	Op. System
	Ecash-ER		Koforidua	WinServer 2012R2
	Ecash_Tafo		Tafo	WinServer 2012R2
	Nkawkaw		Nkawkaw	WinServer 2012R2
	Ho-Prepaid-Svr		Ho	WinServer 2012R2
	Tema		PDS Data Centre	WinServer 2012R2
	Kasoasvr		Kasoa	WinServer 2012R2
	Central-E-cash		Cape Coast	WinServer 2012R2
	Ecash-Takoradi		Takoradi	WinServer 2012R2
	Ecashswedru		Swedru	WinServer 2012R2
	Ecashppmo		Hohoe	WinServer 2012R2
	Winppmsvr01		Winneba	WinServer 2012R2
	Ppmo-AccEast		PDS Data Centre	WinServer 2012R2

Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose		
Database System	Name	Vendor	Version
	Microsoft SQL Server	Microsoft	2008 and 2012
Workstation Software	Name	Version	
	Windows Operating System	Windows 7	

10.3.6.4 MBH CLOU

Table 132: Information System Details – MBH CLOU

Information Requested	Response
General Information	
Application Name	MBH CLOU
Vendor	Shenzhen Clou Electronics
Version	2.1.7.1
Website (URL)	https://www.clouglobal.com/
Documentation (if no website provided, attach documentation and provide filenames)	Yes, a Document on the System has been submitted to Ag. SM Databases Administration
Description / Purpose (short overview)	

Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Vending function Meter reading Reports Asset Management Electricity Management
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Director of Customer Service
ICT Support Staff – Contact Details	Kathlyn Nicco-Annan (Tema Region- Afienya District) Position: Database Administrator Email: knannan@PDSgh.com Mobile: Office: Tema Regional Office P.O. Box 43, Tema
License Agreement	Yes, there was an agreement to supply servers and meters per the contract.
Support / Maintenance Agreement	No separate agreement for hardware maintenance or software maintenance. Software support is provided as and when required, even after contract completion.
Business Units using the system (which modules) and Number of Users	Database Server CSD (8) Analysis Services: Finance (2) Reporting Services: ICT (1) Integration Services: ICT (1)
Locations where use Name offices where Application is accessed	Tema Accra West Eastern
Perception of user community	Good

Information Requested	Response
Data Input What info is fed into the system	Customer Recharge Records Quota Recharge records Vending Station Records User setup
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Daily Input
Master Data used by system Which system is custodian of master data?	Account No. Customer name Custodian: InCMS

Data Output (what info is delivered)	1. Current Day Sales Amount 2. Current Monthly Sales 3. Total terminal connected 4. Total terminal online 5. Total terminal offline			
Frequency of Data Output	Daily			
What is the Data Output used for	Monitoring, financial reporting			
Interfaces (input / output)	Web-portal			
Integration with other systems	InCMS			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	MBH1 Meter FEP		Project Office	Windows 2012 R2
	MBH3- Web FEP Token Server		Project office	Windows 2012 R2
	MBH4- Database Server		Project office	Windows 2012 R2
	MBH6-Report Server ZooKeeper Dubbo Monitor Redis		Project Office	Windows 2012 R2
Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose			
Database System	**Name**	**Vendor**		**Version**
	MySQL	Freeware		Windows 2012 R2
Workstation Software	**Name**		**Version**	
	SZCLOU- STS&AMI		V.2.1.7.1	

10.3.6.5 Nuri Telecom AIMIR

Table 133: Information System Details – Nuri Telecom AIMIR

Information Requested	Response
General Information	
Application Name	AIMIR
Vendor	Nuri Telecom
Version	AIMIR v3.0
Website (URL)	http://192.168.7.22:8085/aimir-web http://nuritelecom.com
Documentation (if no website provided, attach documentation and provide filenames)	No documentation
Description / Purpose (short overview)	Client Server System for Meter Management and Vending Functions

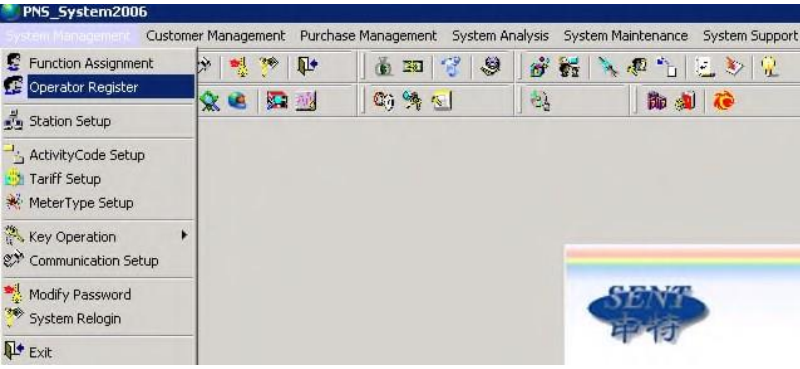|	
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Database Server Analysis Services Reporting Services Integration Services
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Mr. Anthony X. Sossah Position: Ag. General manager/Application Management (ICT) Email: tsossah@PDSgh.com Mobile: Office: Projects Office P.O. Box AN 5278, Accra Office
ICT Support Staff – Contact Details	Kathlyn Nicco-Annan (Tema Region) Position: Database Administrator Email: knannan@PDSgh.com Mobile: Office: Tema Regional Office P.O. Box 43, Tema
License Agreement	Yes, PDS has a License Agreement
Support / Maintenance Agreement	

Information Requested	Response
Business Units using the system (which modules) <u>and</u> Number of Users	Database Server: CSD (7), Finance (2) Analysis Services: Finance (2) Reporting Services: ICT (1) Integration Services: ICT (1)
Locations where use Name offices where Application is accessed	Tema Region Accra East Region
Perception of user community	Good

Data Input What info is fed into the system	Customer Information Supplier information User Information Information about other equipment			
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Hourly data from meter to server			
Master Data used by system Which system is custodian of master data?	Meter Number Customer Name Custodian: InCMS			
Data Output (what info is delivered)	Daily			
Frequency of Data Output	Sales report per Cashier/vendor Lump- sum Sales figure to SUN Systems			
What is the Data Output used for	Financial reporting			
Interfaces (input / output)				
Integration with other systems	InCMS			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	DB Server(backup)		Project Office	Oracle 11g Enterprise
	Pilot Server		Project Office	Oracle 11g Enterprise
	DB Server		Project Office	Oracle 11g Enterprise
	TEST (DEV)		Project Office	Oracle 11g Enterprise
Purpose of Servers				
Database System	**Name**	**Vendor**		**Version**
Workstation Software	**Name**		**Version**	
	Oracle SQL Developer		version 17.3.1.279 Build 279.0537	

10.3.6.6 PNS

Table 134: Information System Details – PNS

Information Requested	Response
General Information	
Application Name	PNS_SYSTEM2006
Vendor	SNEDA
Version	2006
Website (URL)	N/A
Documentation (if no website provided, attach documentation and provide filenames)	N/A

Description / Purpose (short overview)	KWH based prepayment metering system
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Database Server Reading Server
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Director /CSD Ing. Jones Ofori Position: Manager Email: mowusu@PDSgh.com Office: Customer Service Directorate - Accra West

Information Requested	Response
ICT Support Staff – Contact Details	Mrs. Angela Amoh- Antwi Position: Senior Programmer Email: aaantwi@PDSgh.com Office: Projects Office P.O. Box AN 5278, Accra Office Mr. Joshua Bonsu Position: Programmer Email: jbonsu@PDSgh.com Office: Projects Office P.O. Box AN 5278, Accra Office
License Agreement	N/A

Support / Maintenance Agreement	N/A
Business Units using the system (which modules) and Number of Users	Customer Service and Finance System Management Customer Management Purchase Management System, Analysis System Maintenance
Locations where use Name offices where Application is accessed	Accra East Ashanti SBU
Perception of user community	Good
Data Input What info is fed into the system	N/A
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Average Daily Vending Transactions = 25237 Average Daily Meter Setup = 255
Master Data used by system Which system is custodian of master data?	CMS
Data Output (what info is delivered)	Sales Report; Consumption Report; Quota Sales Report; Vending Reports; Reports on Transformers
Frequency of Data Output	Daily; Weekly; Monthly; Query Data in Selected Periods
What is the Data Output used for	Management Decisions; Financial Analysis; Monitoring of Meters
Interfaces (input / output)	N/A
Integration with other systems	CMS
Technical Information	

Server(s) Server Names, IP Addresses, Location, OS	Name	IP Address	Location	Op. System
	N/A	192.168.3.17	Accra East	N/A
	N/A	192.168.60.63	Ashanti SBU	N/A

Purpose of Servers	N/A

Database System	Name	Vendor	Version
	N/A		

Workstation Software	Name	Version
	N/A	

10.3.6.7 PNS Smart

The PNS Smart System is an on-going project and therefore limited information was provided by PDS.
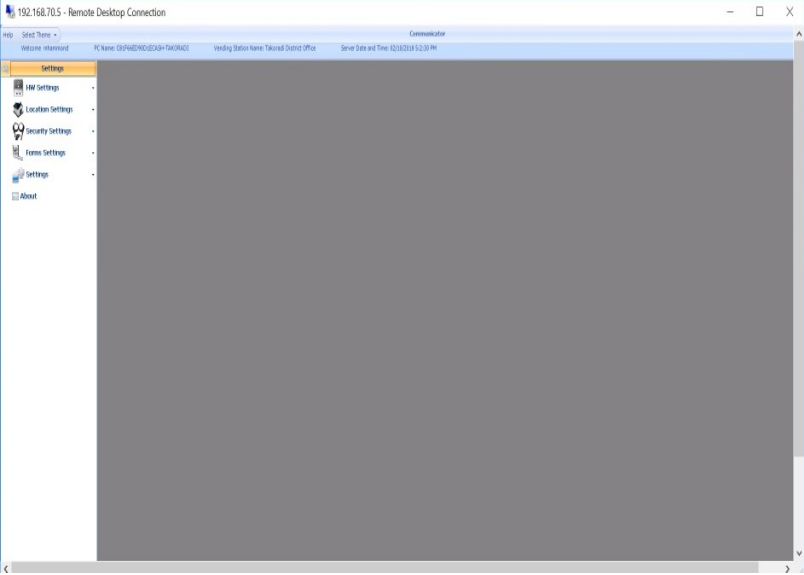
Table 135: Information System Details – PNS Smart

Information Requested	Response
General Information	
Application Name	SQL Server
Vendor	Sneda
Version	2018092801
Website (URL)	N/A
Documentation (if no website provided, attach documentation and provide filenames)	N/A
Description / Purpose (short overview)	N/A
Screenshot of Home Screen/Page (first screen that pops up after login)	N/A
Modules in use	Database Server
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Mr. Eric Ababio /CSD Position: Manager Email: mowusu@PDSgh.com Office: Customer Service Directorate - Accra West
ICT Support Staff – Contact Details	Mr. Michael Hammond Position: Manager/Database Management Email: mhammond@PDSgh.com Office: Projects Office P.O. Box AN 5278, Accra Office
License Agreement	N/A
Support / Maintenance Agreement	N/A
Business Units using the system (which modules) and Number of Users	N/A
Locations where use Name offices where Application is accessed	Pilot in Kwabenya- Accra East
Perception of user community	N/A
Data Input What info is fed into the system	N/A
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	N/A
Master Data used by system Which system is custodian of master data?	N/A
Data Output (what info is delivered)	N/A
Frequency of Data Output	N/A
What is the Data Output used for	N/A
Interfaces (input / output)	N/A
Integration with other systems	

Technical Information

Information Requested	Response			
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	N/A	N/A	N/A	N/A
Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose			
Database System	**Name**	**Vendor**		**Version**
	N/A	N/A		N/A
Workstation Software	**Name**		**Version**	
	N/A		N/A	
	.			

10.3.6.8 SmartG

Table 136: Information System Details – SmartG

Information Requested	Response
General Information	
Application Name	SmartG System
Vendor	Ghana Electrometer
Version	99
Website (URL)	Electrometer.com.gh
Documentation (if no website provided, attach documentation and provide filenames)	N/A
Description / Purpose (short overview)	It is a prepaid metering system that runs on SQLSERVER on Windows platform.
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	N/A
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	The Director of Customer Service, Electricity Company of Ghana
ICT Support Staff – Contact Details	Mr. Michael Hammond; Manager/Database Management Mobile: 0244267868
License Agreement	Yes
Support / Maintenance Agreement	Yes
Business Units using the system (which modules) and Number of Users	Finance, Customer Service
Locations where use Name offices where Application is accessed	Ashanti SBU.
Perception of user community	Good
Data Input What info is fed into the system	Power Usage Details and Commercial Details of the Customer.
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Daily

Information Requested	Response
Master Data used by system Which system is custodian of master data?	Commercial Management System(CMS)
Data Output (what info is delivered)	Sales Information, Billing Information, Power Usage and Customer Information
Frequency of Data Output	Daily
What is the Data Output used for	Reporting and Analysis for every district
Interfaces (input / output)	Input and Output
Integration with other systems	It is integrated with the Commercial Management System
Technical Information	

Server(s) Server Names, IP Addresses, Location, OS	Name	IP Address	Location	Op. System
	N/A	N/A	N/A	N/A

Purpose of Servers	N/A

Database System	Name	Vendor	Version
	SQL Server	Microsoft	2008 and 2012

Workstation Software	Name	Version
	N/A	N/A

10.3.6.9 Liberty

Table 137: Information System Details – Liberty

10.3.6.10 Kamstrut

Table 138: Information System Details – Kamstrut

N/A

10.3.7   Post-paid Management System

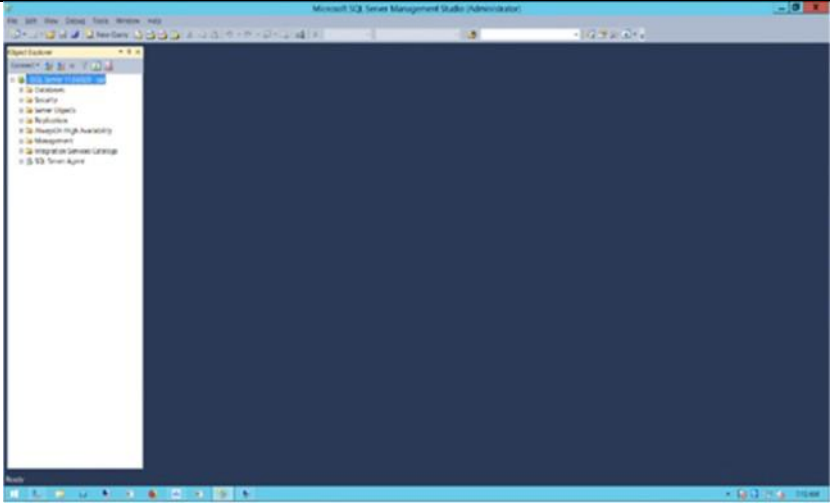### 10.3.7.1 ezViews

Table 139: Information System Details – ezViews

Information Requested	Response
General Information	
Application Name	EZIVIEW
Vendor	EDMI SINGAPORE
Version	N/A
Website (URL)	N/A
Documentation (if no website provided, attach documentation and provide filenames)	N/A
Description / Purpose (short overview)	EDMI METER CONFIGURATION TOOL
Screenshot of Home Screen/Page (first screen that pops up after login)	N/A
Modules in use	N/A
ERP Relevant? (Yes/No)	No
Business Informationen	
Business Owner (Custodian) – Contact Details	MTS -PDS
ICT Support Staff – Contact Details	EMILE KPAKPO ADOTEY (0244047525)
License Agreement	FREE SOFTWARE FROM EDMI
Support / Maintenance Agreement	NONE
Business Units using the system (which modules) and Number of Users	CSD-MTS
Locations where use Name offices where Application is accessed	PROJECT OFFICE
Perception of user community	N/A
Data Input What info is fed into the system	N/A
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	METER CONFIGURATION PARAMETER

Master Data used by system Which system is custodian of master data?	DAILY
Data Output (what info is delivered)	METER READING AND CUSTOMER SERVICE
Frequency of Data Output	N/A
What is the Data Output used for	N/A
Interfaces (input / output)	N/A
Integration with other systems	CMS MULTIDRIVE
Technical Information	

Server(s) Server Names, IP Addresses, Location, OS	Name	IP Address	Location	Op. System
	N/A	N/A	N/A	N/A
	.			.
Purpose of Servers	N/A			

Information Requested	Response		
Database System	Name	Vendor	Version
	N/A	N/A	N/A

Workstation Software	Name	Version
	N/A	N/A

10.3.7.2 Holley EnerSmart

Table 140: Information System Details – Holley EnerSmart

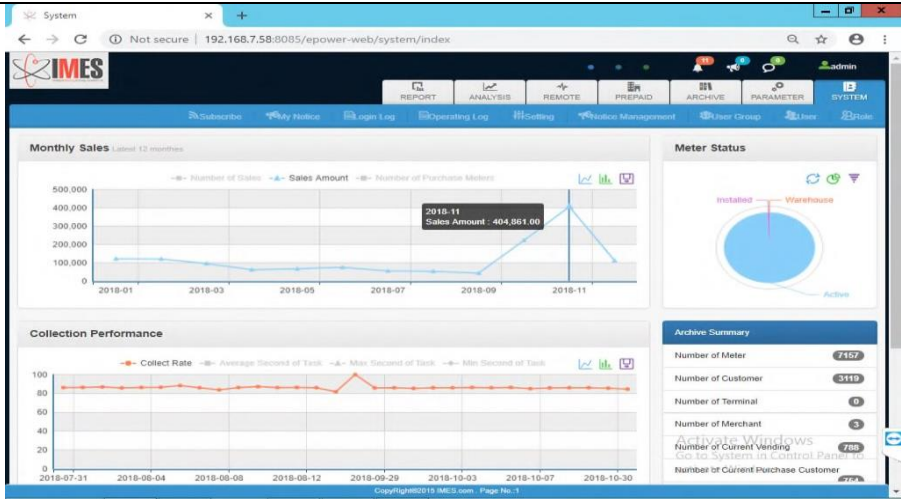| Information Requested	Response
General Information	
Application Name	EnerSmart Per-Paid System
Vendor	Holley Technology, China
Version	Microsoft SQL Database, Standard Edition, 2012
Website (URL)	www.holleyTech.com
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	A relational database management system with the primary function of storing and retrieving data as requested by other software applications — which may run on Windows Server 2012 with application across a network (including the Internet).
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Database Server Analysis Services Reporting Services Integration Services
ERP Relevant? (Yes/No)	Yes = The Application provides functionality that typically is also found in ERP systems or when the Applications needs to exchange information with the future ERP system
Business Information	
Business Owner (Custodian) – Contact Details	Ing.David Asamoah Position: General Manager/ Customer Service Email: dasamoah@PDSgh.com Mobile: Office: Ashanti SBU P.O. Box 1980, Kumasi, HQ
ICT Support Staff – Contact Details	Mr. KORNYO OLIVER Position: Regional Database Administrator/ Application Management (ICT) Email: okornyo@PDSgh.com Mobile: Office: Ashanti SBU P.O. Box 1980, Kumasi, HQ
License Agreement	Indicate if PDS has a License Agreement in place for the Application. If so, provide copy if available
Support / Maintenance Agreement	PDS Supports with supplier (joint support)

Business Units using the system (which modules) <u>and</u> Number of Users	Database Server: CSD, Finance, MIS Analysis Services: Finance and MIS Reporting Services: ICT (2) Integration Services: ICT (2)

Information Requested	Response			
Locations where use Name offices where Application is accessed	Ashanti SBU			
Perception of user community	Good			
Data Input What info is fed into the system	InCMS feeds the information: Account No. Customer name Meter No: GHC			
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Daily (we need 100% accurate data from the system)			
Master Data used by system Which system is custodian of master data?	Account No. Customer name Custodian: InCMS			
Data Output (what info is delivered)	Sales prepaid Reports per Vendor			
Frequency of Data Output	Daily			
What is the Data Output used for	Raising of vendor liability, financial reporting and Management decision Making			
Interfaces (input / output)	Excel, PDF, Text, csv files and Etc			
Integration with other systems	InCMS			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	DATABASE1		Proj. Office DC	Win Srv 2012 R2
	WEBHOST1		Proj. Office DC	Win Srv.2012 R2
Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose			
Database System	**Name**	**Vendor**	**Version**	
	MySQL	Oracle	5.6.41	
Workstation Software	**Name**	**Version**		
	SQL Server Management Studio	2011.110		

10.3.7.3 IMES

Table 141: Information System Details – IMES

Information Requested	Response
General Information	
Application Name	IMES
Vendor	IMES
Version	epower 0208
Website (URL)	http://192.168.7.58:8085/epower-web/system/index

Documentation (if no website provided, attach documentation and provide filenames)	N/A
Description / Purpose (short overview)	Utility system used by PDS for managing and running smart meters.
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	N/A
ERP Relevant? (Yes/No)	Yes, ready for integration with ERP systems
Business Information	
Business Owner (Custodian) – Contact Details	Ashanti SBU GM/ Customer Service
ICT Support Staff – Contact Details	Kornyo Oliver System Administrator (DBA)
License Agreement	N/A
Support / Maintenance Agreement	N/A
Business Units using the system (which modules)and Number of Users	Client Web application for Vending and operation. Token Generated Services service running on the communication server. Number of users around 50 users.
Locations where use Name offices where Application is accessed	Ashanti SBU
Perception of user community	Good
Data Input What info is fed into the system	Customer Info, Meter Info, Tariffs, Payments.

Information Requested	Response
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	N/A
Master Data used by system Which system is custodian of master data?	Customer Info, Meter Info Custodian : CMS

Data Output (what info is delivered)	Operation reports, vending reports, consumption reports, financial reports
Frequency of Data Output	When needed
What is the Data Output used for	Operation and financial reporting
Interfaces (input / output)	HTML, PDF, XLS
Integration with other systems	CMS
Technical Information	

Server(s) Server Names, IP Addresses, Location, OS	Name	IP Address	Location	Op. System	
	Communication & Web application	192.168.7.58	Project office	Windows Server 2012 R2 standard	
	DB server	192.168.2.97	Project office	Windows Server 2012 R2 standard	
Purpose of Servers	The server runs SQL server software and handles the functions required for concurrent, shared data access. The server receives and processes the SQL statements that originate from client applications.				
Database System	Name	Vendor	Version	
	SQL Server	Microsoft	2014	
Workstation Software	Name		Version	

10.3.7.4 L&R CLOU

Table 142: Information System Details – L&R CLOU

N/A

10.3.7.5 Multi-Drive System MTS

Table 143: Information System Details – Multi-Drive System MTS

Information Requested	Response
General Information	
Application Name	MULTI DRIVE
Vendor	EDMI SINGAPORE
Version	N/A
Website (URL)	N/A
Documentation (if no website provided, attach documentation and provide filenames)	N/A
Description / Purpose (short overview)	MULTIDRIVE MOMS
Screenshot of Home Screen/Page (first screen that pops up after login)	N/A
Modules in use	N/A
ERP Relevant? (Yes/No)	No
Business Information	
Business Owner (Custodian) – Contact Details	MTS -PDS
ICT Support Staff – Contact Details	EMILE KPAKPO ADOTEY
License Agreement	LICENSE WITH ANNUAL MAINTENANCE FEE
Support / Maintenance Agreement	N/A
Business Units using the system (which modules) and Number of Users	CSD-MTS
Locations where use Name offices where Application is accessed	ALL REGIONS
Perception of user community	N/A
Data Input What info is fed into the system	N/A
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	METER READING
Master Data used by system Which system is custodian of master data?	DAILY
Data Output (what info is delivered)	BILLING AND METER DATA ANALITICS

Frequency of Data Output	N/A			
What is the Data Output used for	N/A			
Interfaces (input / output)	N/A			
Integration with other systems	N/A			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	N/A	N/A	N/A	N/A
Purpose of Servers	N/A			

Information Requested	Response		
Database System	**Name**	**Vendor**	**Version**
	N/A	N/A	N/A
Workstation Software	**Name**	**Version**	
	N/A	N/A	

10.3.8 Engineering Applications

10.3.8.1 Aspen DistriView

Table 144: Information System Details – Aspen DistriView

Information Requested	Response
General Information	
Application Name	Aspen DistriView
Vendor	Advanced Systems for Power Engineering, Inc. (ASPEN)
Version	10.3
Website (URL)	http://www.aspeninc.com/web/software/distriview
Documentation (if no website provided, attach documentation and provide filenames)	N/A
Description / Purpose (short overview)	Power System Analysis
Screenshot of Home Screen/Page (first screen that pops up after login)	N/A
Modules in use	N/A
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	ASPEN, 49 N. San Mateo Drive San Mateo, CA 94401 U.S.A. Phone: (650) 347-3997 Fax: (650) 347-0233
ICT Support Staff – Contact Details	ASPEN, 49 N. San Mateo Drive San Mateo, CA 94401 U.S.A. Phone: (650) 347-3997 Fax: (650) 347-0233
License Agreement	Yes
Support / Maintenance Agreement	Yes
Business Units using the system (which modules) and Number of Users	System Planning
Locations where use Name offices where Application is accessed	Projects Office
Perception of user community	N/A
Data Input What info is fed into the system	Network details
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	As per assignment
Master Data used by system Which system is custodian of master data?	N/A
Data Output (what info is delivered)	Load Flow results, reliability results etc.
Frequency of Data Output	As per assignment

What is the Data Output used for	Planning of network
Interfaces (input / output)	N/A
Integration with other systems	N/A

Technical Information			

Information Requested	**Response**		

Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	N/A	N/A	N/A	N/A

Purpose of Servers	N/A

Database System	**Name**	**Vendor**	**Version**
	N/A	N/A	N/A

Workstation Software	**Name**	**Version**
	N/A	N/A

10.3.8.2 Cyme Distribution (CymDist)

Table 145: Information System Details – Cyme Distribution (CymDist)

Information Requested	Response
General Information	
Application Name	Cyme Distribution (Cymdist)
Vendor	CYME International T&D Inc.
Version	8.0
Website (URL)	http://www.aspeninc.com/web/software/distriview
Documentation (if no website provided, attach documentation and provide filenames)	N/A
Description / Purpose (short overview)	Power System Analysis
Screenshot of Home Screen/Page (first screen that pops up after login)	N/A
Modules in use	N/A
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	CYME International T&D Inc. 1485 Roberval Street, Suite 104 Saint-Bruno, Quebec, Canada P: +1(450)461-3655 F: +1(450)461-0966 E: cymeino@eaton.com E: cymesupport@eaton.com
ICT Support Staff – Contact Details	CYME International T&D Inc. 1485 Roberval Street, Suite 104 Saint-Bruno, Quebec, Canada P: +1(450)461-3655 F: +1(450)461-0966 E: cymeino@eaton.com E: cymesupport@eaton.com
License Agreement	Yes
Support / Maintenance Agreement	Yes
Business Units using the system (which modules) and Number of Users	System Planning
Locations where use Name offices where Application is accessed	Projects Office
Perception of user community	N/A
Data Input What info is fed into the system	Network details
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	As per assignment
Master Data used by system Which system is custodian of master data?	N/A
Data Output (what info is delivered)	Load Flow results, reliability results, short circuit analysis etc.

Frequency of Data Output	As per assignment
What is the Data Output used for	Planning of network i.e. System studies
Interfaces (input / output)	N/A
Integration with other systems	GIS compliant

Information Requested	Response			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	N/A	N/A	N/A	N/A
Purpose of Servers	N/A			
Database System	**Name**	**Vendor**		**Version**
	N/A	N/A		N/A
Workstation Software	**Name**		**Version**	
	N/A		N/A	

10.3.8.3 CYMGRD

Table 146: Information System Details – CYMGRD

Information Requested	Response
General Information	
Application Name	CYMGRD
Vendor	CYME International T&D Inc.
Version	6.5
Website (URL)	http://www.cyme.com/
Documentation (if no website provided, attach documentation and provide filenames)	N/A
Description / Purpose (short overview)	For Earth Grid Design
Screenshot of Home Screen/Page (first screen that pops up after login)	N/A
Modules in use	N/A
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	CYME International T&D Inc. 1485 Roberval Street, Suite 104 Saint-Bruno, Québec, Canada J3V 3P8 +1 (450) 461-3655
ICT Support Staff – Contact Details	CYME International T&D Inc. 1485 Roberval Street, Suite 104 Saint-Bruno, Québec, Canada J3V 3P8
License Agreement	N/A
Support / Maintenance Agreement	N/A
Business Units using the system (which modules) and Number of Users	Design Division
Locations where use Name offices where Application is accessed	Design Division Office, Project Office
Perception of user community	N/A
Data Input What info is fed into the system	Soil Resistivity Data, System Fault Levels

Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Per Design			
Master Data used by system Which system is custodian of master data?	N/A			
Data Output (what info is delivered)	Earth Grid Design			
Frequency of Data Output	Per Design			
What is the Data Output used for	For constructing an Earth Grid			
Interfaces (input / output)	N/A			
Integration with other systems	GIS compliant			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	N/A	N/A	N/A	N/A
	.			.

Information Requested	Response		
Purpose of Servers	N/A		
Database System	**Name**	**Vendor**	**Version**
	N/A	N/A	N/A
	.		.
Workstation Software	**Name**	**Version**	
	N/A	N/A	

10.3.8.4 PLSCADD

Table 147: Information System Details – PLSCADD

Information Requested	Response
General Information	
Application Name	PLSCADD
Vendor	Power line Systems Inc.
Version	15
Website (URL)	Powline.com
Documentation (if no website provided, attach documentation and provide filenames)	N/A
Description / Purpose (short overview)	Software for sub transmission line design
Screenshot of Home Screen/Page (first screen that pops up after login)	N/A
Modules in use	N/A
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Power line Systems Inc. 610 N. Whitney Way, Suite 160 Madison, WI 53705, U.S.A +1(608) 238-2171 info@powline.com
ICT Support Staff – Contact Details	Power line Systems Inc. 610 N. Whitney Way, Suite 160 Madison, WI 53705, U.S.A +1(608) 238-2171 info@powline.com
License Agreement	N/A
Support / Maintenance Agreement	N/A
Business Units using the system (which modules) and Number of Users	Design Division
Locations where use Name offices where Application is accessed	Projects Office
Perception of user community	N/A
Data Input What info is fed into the system	Survey Data
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Data required for each design
Master Data used by system Which system is custodian of master data?	N/A

Data Output (what info is delivered)	Plan & Profile Design, Staking Table
Frequency of Data Output	Same as number of Design
What is the Data Output used for	The implementation of sub transmission lines
Interfaces (input / output)	N/A

Information Requested	Response			
Integration with other systems	GIS compatible			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	N/A	N/A	N/A	N/A
Purpose of Servers	N/A			
Database System	**Name**	**Vendor**		**Version**
	N/A	N/A		N/A
Workstation Software	**Name**		**Version**	
	N/A		N/A	

10.3.9 PDS Inhouse Developed Systems

10.3.9.1 PDS eTMS

Table 148: Information System Details – PDS eTMS

Information Requested	Response
General Information	
Application Name	eTMS PDS
Vendor	Android Application
Version	
Website (URL)	https://www.itwell.co.kr https://en.smartpeak.cn/Android-POS/
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	An PDS PoS application used for payment of post-paid (Credit meters) and pre-paid (Prepaid meters) bills. It communicates with a middleware that is connected to the central payment database.
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Bills, End of Day, Reports, Synchronization
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Mr. Anthony X. Sossah Position: Ag. General Manager/ Application Management (ICT) Email: tsossah@PDSgh.com Mobile: Office: Projects Office P.O. Box AN 5278, Accra Office
ICT Support Staff – Contact Details	Mr. Henry Otutey Allorgbey Position: Information Technology Officer Email: hallorgbey@PDSgh.com Mobile: 0243051494 Office: Projects Office P.O. Box AN 5278, Accra Office Mr. Oti Boateng Charles Position: Snr. Programmer Email: coboateng@PDSgh.com Mobile: 0553650720 Office: Projects Office P.O. Box AN 5278, Accra Office Mr. Andrew Bimpong Position: Assistant Information Technology Officer Email: abimpong@PDSgh.com Mobile: 0209863796 Office: Projects Office P.O. Box AN 5278, Accra Office
License Agreement	
Support / Maintenance Agreement	
Business Units using the system (which modules) and Number of Users	eTMS PDS: Cashiers, Supervising cashiers, Bonded Cashiers Customer Service Finance

Locations where use Name offices where Application is accessed	Regional Offices District Offices Out stations
Perception of user community	Good

Information Requested	Response				
Data Input What info is fed into the system	Customer Account Number, Amount Staff Number, Dates				
Frequency of Data Input Transaction volume per dataset (e.g. new connections)					
Master Data used by system Which system is custodian of master data?	InCMS				
Data Output (what info is delivered)	Daily Sales Report, Customer information				
Frequency of Data Output	Daily				
What is the Data Output used for	For financial analysis and tracking the daily, weekly and monthly collection				
Interfaces (input / output)	Excel, pdf				
Integration with other systems	InCMS				
Technical Information					
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**	
	BillsPayment		Proj. Office DC	Win Srv 2012 R2	
	Reporting Server		Proj. Office DC	Win Srv 2012 R2	
Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose				
Database System	**Name**	**Vendor**		**Version**	
	MSSQL	Microsoft		12.0.4100.1	
Workstation Software	**Name**		**Version**		
	SQL Server Management Studio		12.0.4100.1		

10.3.9.2 PDS Payment Platform

Table 149: Information System Details – PDS Payment Platform

Information Requested	Response
General Information	
Application Name	Payment Platform
Vendor	PDS
Version	Version 2
Website (URL)	
Documentation (if no website provided, attach documentation and provide filenames)	

Description / Purpose (short overview)	The payment platform is used for receiving revenue. It is used for receipting post-paid bills. PDS uses it for various applications as back-end, e.g. SharePoint.
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Desktop service Point of sales (PoS) Reporting Services
ERP Relevant? (Yes/No)	**Yes** = The Application provides functionality that typically is also found in ERP systems or when the Applications needs to exchange information with the future ERP system
Business Information	
Business Owner (Custodian) – Contact Details	Director of Finance
ICT Support Staff – Contact Details	Mr. Charles Oti Boateng Position: Analyst Programmer / Application Management (ICT) Email: coboateng@PDSgh.com Mobile: Office: Projects Office P.O. Box AN 5278, Accra Office
License Agreement	In House
Support / Maintenance Agreement	In House
Business Units using the system (which modules) and Number of Users	Desktop: Finance Point of Sales (POS): Finance Reporting Services: CSD and Finance
Locations where use Name offices where Application is accessed	In all PDS Operational Areas
Perception of user community	Good
Data Input What info is fed into the system	SMARTG feeds the information: • Account No. • Customer name • Electricity paid • GHC
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Daily

Information Requested	Response
Master Data used by system Which system is custodian of master data?	Account No. Customer name Custodian: InCMS
Data Output (what info is delivered)	Sales Reports per cashiered, district, region and vendor
Frequency of Data Output	Daily
What is the Data Output used for	Raising of vendor liability, financial reporting
Interfaces (input / output)	Manual
Integration with other systems	InCMS

Technical Information						
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**		**Location**	**Op. System**	
	BILLPAYMENTSVR			Proj. Office DC	Win Srv	
	CALL CENTRE			Proj. Office DC	Win Srv	
	WEBSERVER01			Proj Office DC	Win srv	
Purpose of Servers:	Provide data flow diagram how servers interact plus short description of server purpose					
Database System	**Name**		**Vendor**		**Version**	
	MySQL		Oracle		5.6.41	
Workstation Software	**Name**			**Version**		
	SQL Server Management Studio			2011.110		

10.3.9.3 PDS Desktop Payment Application

Table 150: Information System Details – PDS Desktop Payment Application

Information Requested	Response
General Information	
Application Name	Desktop Payment Application
Vendor	PDS
Version	
Website (URL)	
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	A desktop application used by our cashiers for collecting post-paid bills. It is not a webbased application and it has to be installed on individual PCs using the installer file. It is connected to the central database at the datacentre. Developed with Visual Studio 2010.
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Bills Payment, Reports,
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Mr. Anthony X. Sossah Position: Ag. General Manager/ Application Management (ICT) Email: tsossah@PDSgh.com Mobile: Office: Projects Office P.O. Box AN 5278, Accra Office
ICT Support Staff – Contact Details	Mr. Oti Boateng Charles Position: Snr. Programmer Email: coboateng@PDSgh.com Mobile: Office: Projects Office P.O. Box AN 5278, Accra Office
License Agreement	N/A
Support / Maintenance Agreement	N/A
Business Units using the system (which modules) and Number of Users	Bills Payment: Cashiers, Supervising cashiers Reports: CRA(s) , Cashiers, Supervising Cashiers
Locations where use Name offices where Application is accessed	Head office Regional Offices District Offices
Perception of user community	
Data Input What info is fed into the system	Customer Account Number, Amount Staff Number, Dates
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	
Master Data used by system Which system is custodian of master data?	InCMS

Data Output (what info is delivered)	Daily Sales Report, Customer information
Frequency of Data Output	Daily
What is the Data Output used for	For financial analysis and tracking the daily, weekly and monthly collection
Interfaces (input / output)	Excel, pdf
Integration with other systems	InCMS
Technical Information	

Information Requested	Response				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**	
	BillsPayment		Proj. Office DC	Win Srv 2012 R2	
	Reporting Server		Proj. Office DC	Win Srv 2012 R2	
Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose				
Database System	**Name**	**Vendor**		**Version**	
	MSSQL	Microsoft		12.0.4100.1	
Workstation Software	**Name**		**Version**		
	SQL Server Management Studio		12.0.4100.1		

10.3.9.4 PDS Fuel Tracking System

Table 151: Information System Details – PDS Fuel Tracking System

Information Requested	Response
General Information	
Application Name	Fule Tracking System
Vendor	PDS
Version	Version 1
Website (URL)	Internal
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	The system is used to track fuel usage
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	PoS
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Director Materials and Transport
ICT Support Staff – Contact Details	Mr. Charles Oti Boateng Position: Analyst programmer / Application Management (ICT) Email: coboateng@PDSgh.com Mobile: Office: Projects Office P.O. Box AN 5278, Accra Office
License Agreement	In house
Support / Maintenance Agreement	In house
Business Units using the system (which modules) and Number of Users	Transport
Locations where use Name offices where Application is accessed	All PDS Operational Areas
Perception of user community	Good
Data Input What info is fed into the system	Fuel quantity allocated to vehicles daily
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	Daily
Master Data used by system Which system is custodian of master data?	Quantity of fuel Transport Custodian = Same System
Data Output (what info is delivered)	Reports
Frequency of Data Output	Daily
What is the Data Output used for	Generating Reports on fuel allocated
Interfaces (input / output)	

Integration with other systems					
Technical Information					
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**	
	BILLPAYMENTSVR		Project office	Windows Server	
Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose				

Information Requested	**Response**			
Database System	**Name**	**Vendor**	**Version**	
Workstation Software	**Name**		**Version**	

10.3.9.5 PDS AMR Web Application

Table 152: Information System Details – Multi-Drive System MTS

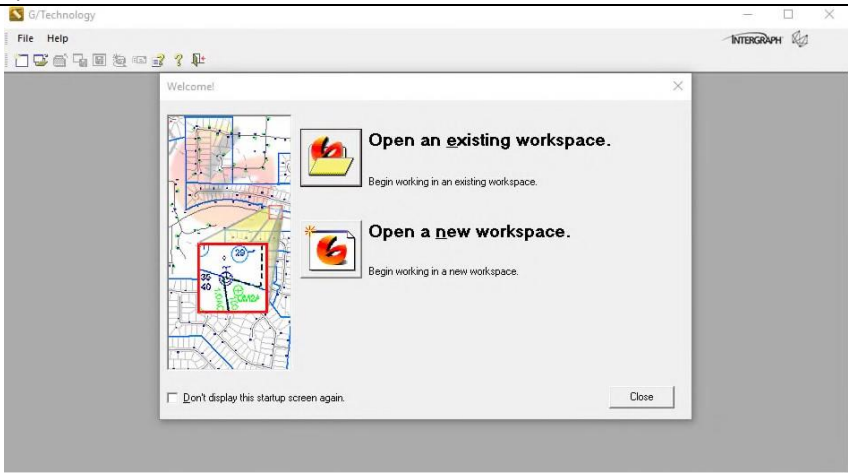| Information Requested	Response
General Information	
Application Name	MULTI DRIVE
Vendor	EDMI SINGAPORE
Version	N/A
Website (URL)	N/A
Documentation (if no website provided, attach documentation and provide filenames)	N/A
Description / Purpose (short overview)	MULTIDRIVE MOMS
Screenshot of Home Screen/Page (first screen that pops up after login)	N/A
Modules in use	N/A
ERP Relevant? (Yes/No)	No
Business Information	
Business Owner (Custodian) – Contact Details	MTS -PDS
ICT Support Staff – Contact Details	EMILE KPAKPO ADOTEY
License Agreement	LICENSE WITH ANNUAL MAINTENANCE FEE
Support / Maintenance Agreement	
Business Units using the system (which modules) and Number of Users	CSD-MTS
Locations where use Name offices where Application is accessed	ALL REGIONS
Perception of user community	N/A
Data Input What info is fed into the system	N/A
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	METER READING
Master Data used by system Which system is custodian of master data?	DAILY
Data Output (what info is delivered)	BILLING AND METER DATA ANALITICS

Frequency of Data Output	N/A			
What is the Data Output used for	N/A			
Interfaces (input / output)	N/A			
Integration with other systems	N/A			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
	N/A	N/A	N/A	N/A
Purpose of Servers	N/A			

Information Requested	Response		
Database System	**Name**	**Vendor**	**Version**
	N/A	N/A	N/A
Workstation Software	**Name**	**Version**	
	N/A	N/A	

10.3.10   Planned and Upcoming Business Systems

10.3.10.1 Geographical Information System (GIS) - Hexagon

Table 153: Information System Details – GIS Hexagon

Information Requested	Response
General Information	
Application Name	G/TECHNOLOGY
Vendor	INTERGRAPH SG&I DEUTSCHLAND GMBH DIVISION HEXAGON SAFETY & INFRASTRUCTURE
Version	10.03.0200.03003
Website (URL)	http://as-prod-1.PDSgh.com/networksportal
Documentation (if no website provided, attach documentation and provide filenames)	GTechnology Guide
Description / Purpose (short overview)	GIS implementation in the Accra East and Accra West operational areas that will allow PDS maintain a master of records and electrical connectivity model of its electrical asset as the foundation for a number of industry focused applications that will support key business processes across multiple business units ~Hope to extend it to cover all PDS operational areas
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	N/A
ERP Relevant? (Yes/No)	Yes
Business Information	
Business Owner (Custodian) – Contact Details	Name: Ing. Samuel Laryea Khartey Position: Director/ MCC Foundational Projects Email: lkhartey@PDSgh.com Tel:0208140830 Office: {Location: 14th Floor, Heritage Towers, Accra}. {Address Electro-Volta house, P. O Box GP 521 Accra}
ICT Support Staff – Contact Details	Name: Aheng Owusu-Afriyie Position: GM/ IT Infrastructure Email: aoafriyie@PDSgh.com Tell: 0244381683 Office: Projects Office P.O. Box AN 5278, Accra Office
License Agreement	Currently 15 Designer Licenses and 5 admin Licenses (Accra East and West) ~300 designer and 750 Admin Licenses estimated to cover the whole of PDS
Support / Maintenance Agreement	Two years maintenance contract (Within MiDA's scope)

Business Units using the system (which modules) and Number of Users	CSD. Operations, Engineering, Network Projects

Information Requested	Response
Locations where use Name offices where Application is accessed	All District Offices Within Accra East and West
Perception of user community	N/A
Data Input What info is fed into the system	AMP (AutoCAD and Excel) and TAA (Mssql database file)/ pdf Equipment layout/ AutoCAD of Substation Design
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	N/A
Master Data used by system Which system is custodian of master data?	N/A
Data Output (what info is delivered)	N/A
Frequency of Data Output	N/A
What is the Data Output used for	N/A
Interfaces (input / output)	CIM Interface ready
Integration with other systems	Through ESB to CMS. CymDist, OMS, ADMS
Technical Information	

Server(s) Server Names, IP Addresses, Location, OS	Name	IP Address	Location	Op. System
	Application Server	N/A	Projects Office	Windows Server 2016 Standard
	File Server	N/A	Projects Office	Windows Server 2016 Standard
	Plot Server	N/A	Projects Office	Windows Server 2016 Standard

Purpose of Servers	N/A

Database System	Name	Vendor	Version
	Oracle	Oracle	Oracle 12.2.0.1.0 Standard Edition 2

Workstation Software	Name	Version
	G/Technology	10.03.0200.03003

10.3.10.2 Meter Management System (MMS)

Meter Management Systems perform long-term data storage and management for data delivered by electric metering systems. This data consists primarily of usage data and events that are imported from the head-end servers managing the data collection. Often meter data analytics is incorporated which analyse data emitted by electric meters that record consumption of electric energy.

MiDA issued an RFP to procure the supply, installation and commissioning of a Meter Management System and Associated Integration to Other Systems on behalf of the PDS.

Siemens, in cooperation with Syntell, proposed a solution based on Siemens MindSphere Internet of Things operating system and MindApps: EnergyIP. For further details refer to the attachment listed under section **Error! Reference source not found.** and **Error! Reference so urce not found.**.

10.3.10.3 ADMS / OMS

An Advanced Distribution Management System (ADMS) is a software platform that supports the full suite of distribution management and optimisation. An ADMS includes functions that automate outage restoration and optimize the performance of the distribution grid. ADMS functions being developed for electric utilities include fault location, isolation and restoration; volt/volt-ampere reactive optimization; conservation through voltage reduction; peak demand management; and support for microgrids and electric vehicles.

An Outage Management System (OMS) provides the capability to efficiently identify and resolve outages and to generate and report valuable historical information. It also helps the utility to inform the customer of the outage situation and restoration status (rather than the customer informing the utility first). An OMS typically works in conjunction with geographic information systems (GIS), the utility's customer information system (CIS), and automated call handling systems, such as an interactive voice response (IVR) system.

Today, with the increasing requirements on utilities to track and report outages accurately, OMS is a critical analysis tool. Functions that an OMS may support include accurate time stamping of outages and restoration by customer, crew tracking, predicting of outage causes, generating information of interest to customers, and creating call-back lists and reports for management and regulatory reasons.

Major functions usually found in an OMS include:

- Prediction of location of transformer, fuse, recloser or breaker that opened upon failure.

- Prioritising restoration efforts and managing resources based upon criteria such as locations of emergency facilities, size of outages, and duration of outages.

- Providing information on extent of outages and number of customers impacted to management, media and regulators.

- ▪ Calculation of estimation of restoration times.

- ▪ Management of teams assisting in restoration.

- ▪ Calculation of teams required for restoration.

10.3.10.4 Enterprise Asset Management System (EAM)

Enterprise Asset Management is the management of the assets of an enterprise across departments, facilities, business units and geographical locations. EAM integrates techniques for holistic control and optimisation throughout asset life cycles, including design, commissioning, operations and replacement.

EAM is categorised into:

- ▪ Physical asset and infrastructure management;

- ▪ IT service management;

- ▪ Digital asset (electronic media and content) management;

- ▪ Fixed asset management and accounting; and ▪ Emerging asset management.

The EAM framework optimises and extends asset life cycles and reduces Total Cost of Ownership (TCO) while maximizing Overall Asset Productivity (OAP) and Return on Assets (ROA), which is key for any industry with high-value equipment.

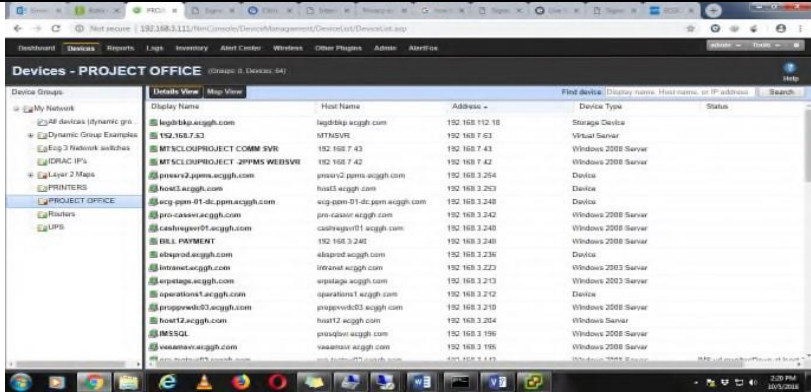In summary, EAM is geared toward the following results:

- ▪ Maximised ROA;

- ▪ Reduced costs and risks;

- ▪ Improved asset decision making;

- ▪ Compliance with required regulations;

- ▪ Increased asset service responses and enhanced efficiency; and ▪ Lowered TCO.

10.4   ICT Systems

10.4.1   IpSwitch Whatsup Gold

Table 154: Information System Details – IpSwitch Whatsup Gold

Information Requested	Response
General Information	
Application Name	WhatsUp Gold
Vendor	IpSwitch
Version	16.2.9
Website (URL)	http://192.168.3.111

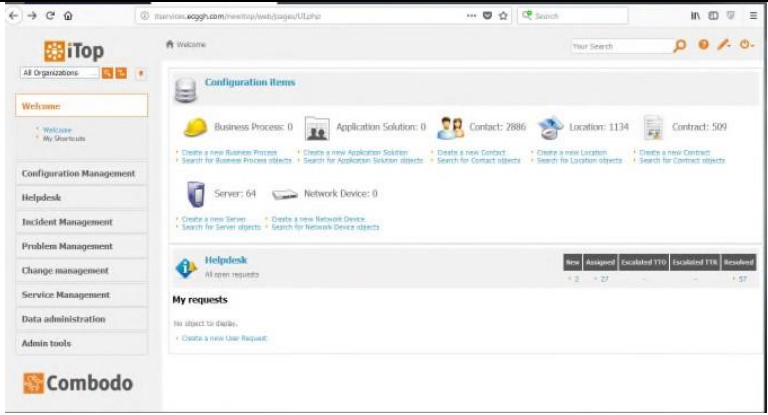|	
Documentation (if no website provided, attach documentation and provide filenames)	http://www.whatsupgold.com/wug162webhelp
Description / Purpose (short overview)	A system for monitoring critical servers and other devices on the network
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	
ERP Relevant? (Yes/No)	No
Business Information	
Business Owner (Custodian) – Contact Details	ICT-IM
ICT Support Staff – Contact Details	ICT-IM
License Agreement	Perpetual
Support / Maintenance Agreement	
Business Units using the system (which modules) and Number of Users	ICT-IM
Locations where use Name offices where Application is accessed	Project Office and All regional ICT offices
Perception of user community	Good
Data Input What info is fed into the system	Information about critical servers
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	As and when there is a new critical device or server in the system
Master Data used by system Which system is custodian of master data?	Server IP address, name and location
Data Output (what info is delivered)	Status of system (whether down or up)

Information Requested	Response
Frequency of Data Output	24hrs a day
What is the Data Output used for	Attending to issues (downtime)
Interfaces (input / output)	
Integration with other systems	No inet
Technical Information	

Server(s) Server Names, IP Addresses, Location, OS		**Name**	**IP Address**	**Location**	**Op. System**	
		WhatsupGold		Main DataCenter	Win 2008R2	
Purpose of Servers		Provide data flow diagram how servers interact plus short description of server purpose				
Database System		**Name**	**Vendor**		**Version**	
		SQL				
Workstation Software		**Name**		**Version**		

10.4.2 Combodo iTop
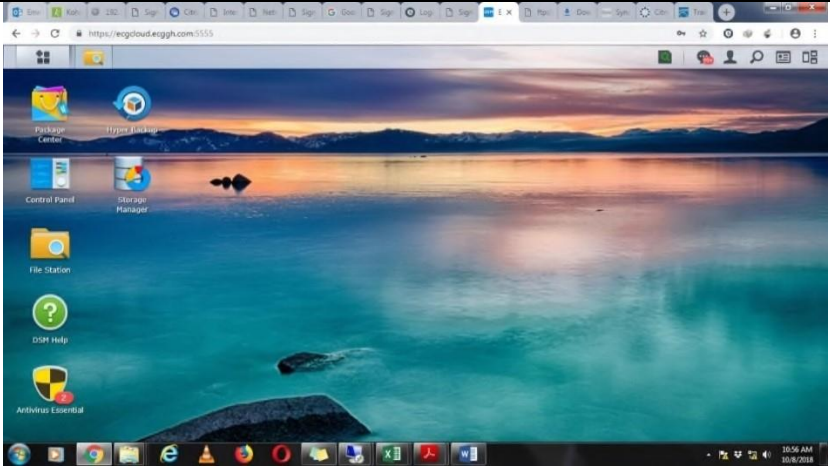
Table 155: Information System Details – Combodo iTop

Information Requested	Response
General Information	
Application Name	iTop
Vendor	Combodo
Version	v2.3.3-3159, built on 2016-12-22 17:35:48
Website (URL)	http://www.combodo.com
Documentation (if no website provided, attach documentation and provide filenames)	
Description / Purpose (short overview)	ICT Incident Management system. For tracking reported ICT incidents
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	Configuration Management, Help Desk, Incidents Managements, Service Managements, Data Administration, Admin Tools
ERP Relevant? (Yes/No)	No
Business Information	
Business Owner (Custodian) – Contact Details	Director of ICT
ICT Support Staff – Contact Details	Delali Atsu
License Agreement	Open Source
Support / Maintenance Agreement	None
Business Units using the system (which modules) and Number of Users	For the whole of PDS Staff
Locations where use Name offices where Application is accessed	Projects Office Support Team, Accessed by Service Desk Level 1 users
Perception of user community	See it difficult to channel their ICT related issues to a Service Desk if there are closer to ICT Staff that can help.
Data Input What info is fed into the system	User calls logged and Support Agents write-ups of issues resolved
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	On a normal day more than twenty (20) user calls are logged into the system, while the number can go up during mid-critical times.
Master Data used by system Which system is custodian of master data?	
Data Output (what info is delivered)	A report of calls logged, Tracking incidents in the system

Information Requested	Response			
Frequency of Data Output				
What is the Data Output used for				
Interfaces (input / output)				
Integration with other systems	Is integrated to the Domain Controller			
Technical Information				
Server(s) Server Names, IP Addresses, Location, OS	**Name**	**IP Address**	**Location**	**Op. System**
Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose			
Database System	**Name**	**Vendor**		**Version**
Workstation Software	**Name**		**Version**	

10.4.3 PDSCLOUD

Table 156: Information System Details – PDSCLOUD (Synology DSM)

Information Requested	Response
General Information	
Application Name	PDSCLOUD
Vendor	Synology
Version	DSM 6.2-23739
Website (URL)	http://PDScloud.PDSgh.com
Documentation (if no website provided, attach documentation and provide filenames)	https://www.synology.com/en-global
Description / Purpose (short overview)	A private cloud system for end users
Screenshot of Home Screen/Page (first screen that pops up after login)	
Modules in use	
ERP Relevant? (Yes/No)	No
Business Owner (Custodian) – Contact Details	ICT-IM
ICT Support Staff – Contact Details	ICT-IM
License Agreement	
Support / Maintenance Agreement	
Business Units using the system (which modules) and Number of Users	ICT-IM
Locations where use Name offices where Application is accessed	Project Office and All regional offices
Perception of user community	Good
Data Input What info is fed into the system	Critical corporate documents of users
Frequency of Data Input Transaction volume per dataset (e.g. new connections)	As and when users upload data

Master Data used by system Which system is custodian of master data?	Users corporate critical documents
Data Output (what info is delivered)	N/A

Information Requested	Response
Frequency of Data Output	24hrs a day
What is the Data Output used for	N/A
Interfaces (input / output)	
Integration with other systems	
Technical Information	

Server(s) Server Names, IP Addresses, Location, OS	Name	IP Address	Location	Op. System	
	PDScloud.PDSghc.om	192.168.3.37	Main Data Centre	DSM	

Purpose of Servers	Provide data flow diagram how servers interact plus short description of server purpose

Database System	Name	Vendor	Version	

Workstation Software	Name	Version	

10.4.4   SysAid ITSM, Service Desk and Help Desk

N/A