Gavi Study – Cold Chain Equipment Maintenance Services and Marketplace Feasibility

Executive Summary

February 2016

An Activity Of The Gavi 2016-2020 Supply Chain Implementation Strategy Through The Gavi Private Sector Priority Working Group Commissioned To Imperial Health Sciences

Gavi The Vaccine Alliance

IMPERIAL HEALTH SCIENCES

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Contents

1. Background 3
1.1. Cold Chain Maintenance in Effective Vaccine Management 3
1.2. The Private and Public Sectors 3
2. Introduction to the Study 4
2.1. Aims of the Study 4
2.2. Outputs of the Study 4
3. Scope of the Study and Summary of Key Findings 5
3.1. What does the CCE Maintenance Services market look like? 5
3.1.1. Key Findings 5
3.2. What different types of maintenance “models” exist both for public and private sectors? 6
3.2.1. Key Findings 6
3.3. Are there market failures? Which ones? 7
3.3.1. Key Findings 7
3.4. Is there scope to apply generic market shaping strategies? Which ones? 8
3.4.1. Key Findings 8
4. Toolkit 9
4.1. Cold Chain Equipment (CCE) maintenance guide 9
4.2. Costing Model Framework 10
4.3. Private Sector Best Practice for CCE Maintenance 10
5. Further Recommendations for Gavi Alliance and Secretariat 11
6. Acknowledgements 12
7. Abbreviations 12
8. References 13
Annex 1 – Example of Good Practice CCE Approach 15
ATS Group – South Africa – Non Healthcare Sector 15
Annex 2 – Maintenance Models and Types 16

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1. Background

1.1. Cold Chain Maintenance in Effective Vaccine Management

The World Health Organization (WHO) reports that the Effective Vaccine Management (EVM) Assessment[1] found that 71% of countries require an improvement to their vaccine cold chain in order to meet the WHO minimum recommended standards for temperature control. One of the key components of the minimum standards is the deployment, effective use and maintenance of cold chain equipment (CCE).

The Cold Chain Equipment (CCE) Optimisation Platform (the Platform) is an initiative encompassed by Gavi's Supply Chain Strategy, which identified poorly maintained CCE as a major challenge of immunization supply chain that needs to be addressed. The creation of the Platform was approved by the Board in June 2015 to strengthen country cold chain systems and advance the Alliance's Supply Chain Strategy and, ultimately, coverage and equity goals.

The initiative will help countries to improve the efficiency and safety of vaccines by increasing CCE operating time, reducing running costs, improving temperature control and extending the geographic coverage of the cold chain. The platform will focus on promoting the right kind of technologies and ensuring reliable and robust equipment performance. It will support the purchase, delivery and training of higher-performing devices, as well as providing technical assistance to assist countries in making decisions about CCE structure, maintenance and budgets.

This report highlights the critical role of an effective and efficient CCE maintenance program in the overall objective of achieving the WHO recommended standards for temperature control.
The outputs of this study will help inform countries of CCE guidance and maintenance models via the CCE Optimisation Platform while helping to create an environment encouraging private sector engagement.

1.2. The Private and Public Sectors

For over a decade, development partners and donors have been encouraging governments in developing countries to explore ways of working with the private sector to reduce costs and improve service delivery.[2] The Gavi Alliance's Supply Chain Strategy and CCE Optimisation Platform recognize that the public sector can benefit greatly from private sector input and involvement to address the aforementioned supply chain challenges and help create a long-term sustainable model. The private sector has developed market driven, efficient supply chains and advances that the public sector can learn from, and stimulating the demand for local private sector partners moves towards a sustainable country and regional level model.

Due to its competitive nature, the private sector is often responsible for developing industry best practice, while focusing on increases in efficiency. In developing environments, the private sector approaches this challenge by responding to the requirements of clients and products, meeting regulatory compliance, obtaining, developing and retaining the required capacity of HR skills, as well as achieving cost competitiveness and profit objectives.

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[1] The assessment has been carried out in over 70 countries between 2010 and 2012. The EVM initiative was launched by WHO and UNICEF and provides materials and tools needed to monitor and assess vaccine supply chains and help countries to improve their supply chain performance.

[2] Transaid: Outsourcing the Distribution Component of Vaccine and Medicine Supply Chains, December 2015.

At its core, the public health sector has the social responsibility to deliver expanding health services to its citizens. Further, it must ensure compliance with public policy across multiple government departments, both at National and Provincial level, each consisting of complex executive management structures. As such, there is often a tendency towards complete ownership over all the assets and human resources required, and the resulting processes these produce. This multi-departmental silo structure, where each public entity is responsible for the service delivery, often results in the public sector having limited experience in managing service level contracts across departments or levels. There are typically limited central structures managing consolidated service levels and their associated performance measures, and hence limited monitoring of whether service providers meet or exceed the required performance.

The public health supply chain continues to face challenges in ensuring CCE compliance, the requirements of which include the effective and efficient maintenance of cold chain equipment. By researching various models of CCE maintenance across sectors, the present study set out to identify cost effective maintenance approaches used to inform the CCE Maintenance Guide, Costing Model Framework and Private Sector Best Practice tools.

2. Introduction to the Study

2.1. Aims of the Study

This Executive Summary provides an overview of the Gavi Cold Chain Equipment (CCE) Maintenance Services and Marketplace Feasibility Study, completed between January and February 2016.

The broad aim of the study was to explore different Cold Chain Equipment (CCE) maintenance models from both public and private sectors, providing a landscape of current capabilities that exist at a country level. Additionally, the study looked to identify promising practices that can be applied, while also exploring opportunities where markets need to be further developed so private sector partners can be better leveraged in strengthening CCE maintenance and management.

In doing so, the study sought to answer the following questions:

1. **What does the CCE Maintenance Services market look like?**
2. **What different types of maintenance "models" exist both for public sector and private sector?**
3. **Are there market failures? Which ones?**
4. **Is there scope to apply generic market shaping strategies? Which ones?**

2.2. Outputs of the Study

Following a landscape analysis across countries and sectors, the results of the study were used to develop three major tools for use by Gavi and Gavi-supported countries:

1. **Cold Chain Equipment Maintenance Guide** to be used by countries to understand choices for CCE maintenance and how to engage options

2. **Costing Model Framework** to assist countries in determining the lifetime cost of different types of equipment and aid in planning and budgeting
3. **Private Sector Best Practice for CCE Maintenance** to demonstrate the capacity of local private sector service providers and their operating models

3. Scope of the Study and Summary of Key Findings

3.1. What does the CCE Maintenance Services market look like?

The study reviewed private sector CCE maintenance activities across African several countries, organizations and industries. The study was divided into two review processes: a desk review and three in-country visits (DRC, Kenya, Malawi). This analysis informed the **landscape analysis**, the key findings of which are described below.

The landscape analysis aims to assess:

- How CCE maintenance is performed in country and across sectors
- The capacity of local private sector to perform cold chain maintenance
- The general operating model in terms of staffing, process, costing, performance & metrics, and 3M (materials, money, manpower)
- Strategic planning of maintenance, such as equipment standardization and spare parts planning

3.1.1. Key Findings

- A limited number (less than 10 per country) of privately-owned CCE maintenance companies[3] (or service providers) account for the majority of the CCE maintenance services provided in DRC, Kenya and Malawi
- In most African countries reviewed, maintenance activities are managed, employed and sourced in-country within the private sector companies
- A **repair or curative maintenance approach**[4] was prevalent over a preventative maintenance strategy
- A high percentage of public and private entities use the **hybrid model** approach or a fully outsourced approach for maintenance (see section 3.2.1)
- There is a limited skill base to support electrical and refrigeration specific repairs, even in the private sector context
- This is additionally challenged by the limited availability of replacement equipment and parts, leading to limited maintenance support

[3] *The companies were not assessed for their competency, skill or service levels*

[4] *Refer to Gavi, CCE Guidance Document, February 2016*

- Refrigerator users, regardless of size, equip generators as a contingency to address the **disruptions of grid supply power**. There was a distinct lack of a **formal redundancy process or plan** to ensure 100% uptime of CCE. Organisations currently report that the majority of repairs are electrical in nature due to surges when the power supply returns.
- **Battery-operated temperature monitoring devices** are key in private sector preventative maintenance, as opposed to the **min/max visual indicated non-powered thermometers** used predominantly in the public sector
- **No visible evidence** of use of second generation technology solar powered equipment. Similarly noted a **very limited awareness** of this technology amongst private sector maintenance service providers.
- The use of a **service level agreement** (SLA), or contract, was evident in most client/service provider relationships. In some instances contracts were limited in scope if compared to larger private sector companies.

For complete analysis refer to ***CCE Maintenance Country Landscape*** document and ***CCE Maintenance Case Studies for Marketplace Analysis*** document.

3.2. What different types of maintenance "models" exist both for public and private sectors?

The study set out to understand the models for maintenance in the private health and non-health sectors, as well as within the public sector and in public private partnerships[5]. The study then sought to use this understanding to inform the Maintenance Guide with regard to the choices of equipment and how these options can be engaged (see section 4.1).

3.2.1. Key Findings[6]

- The study confirmed the existence and relative occurrence of three maintenance models[7]:
  - **Insourced** (very limited, almost none): the business function is performed internally and may include sourcing specialists to fill temporary needs or training existing personnel for a task
  - **Outsourced** (limited): business processes or activities are contracted out to another party with which the organization has a service level agreement for the required services
  - **Hybrid** (majority): a mixed approach which leverages both insourcing and outsourcing of activities with responsibilities clearly defined

[5] *See table in Section 4.3 and Section 8 for country list*

[6] *See Annex 1 for example of ATS Group, South Africa, Non-Health Sector*

[7] *See Annex 2 for maintenance models used by the organisations studied*

- The study found that a key private sector consideration used to determine the ownership of a business function depends on whether the function is **core**, **primary** or **secondary** to their organizational goals.
- **Non-core** activities may support the essential functions that an organization delivers, but can be considered for **outsourcing** to organizations for which they are a core business.
- Examples of the key factors considered when selecting an implementation model or sourcing approach include:

Approach	Key Considerations
Insourced	• Varied skill levels • Availability of training resources or apprentices for staff • Availability of small spares on site • Maintenance may be carried out by someone who is not a refrigeration technician (e.g. electrician or general handyman)
Outsourced	• Repairs are most often carried out by refrigeration technician • Spares are not available on site
Hybrid	• Most likely for spares to be available on site • Small repairs often completed in-house while bigger jobs are outsourced
Other	• Maintenance plan consists of equipment replacement when required, in order to leverage access to warranty

For full analysis, please refer to Sections 2 and 3 of Case Study Document and Section 4 of Country Landscapes Document.

3.3. Are there market failures? Which ones?

This section of the study constitutes an understanding of the pre-conditions for successful private sector engagement, informing on the market feasibility and what failures currently prevent a healthy market place for cold chain equipment maintenance service providers.

3.3.1. Key Findings

Market failure often occurs due to inefficiency in service allocation, or failure of price mechanisms to account for all costs and benefits involved in the required maintenance service. Specific situations found to contribute to market failure include:

- **Maintenance contracts failure:** Challenges presented due to both the buyer of the service (e.g. lack of contract management) and the service provider (e.g. contract obligations not met)
- **Spare parts:** Lack of available critical spare parts in country when required
- **Skills training:** Lack of ongoing, up to date training on newer technologies for technicians
- **Threat of theft:** High value technology is often a target for theft in developing countries

- **Market dynamics:** The maintenance market in a country may feature economies of scale or significant start-up costs, potentially giving rise to inefficient market outcomes if a few large service providers are able to exclude others
- **Lack of public services**
- **Poor visibility of information:** One or more parties lack material information which would affect whether or not the service occurs, or the price of the service (e.g. CCE condition information, location of CCE).

For full analysis, please refer to **Section 1** ***CCE Maintenance Case Studies for Marketplace Analysis*** document.

3.4. Is there scope to apply generic market shaping strategies? Which ones?

This section of the study set out to examine the steps needed to create an active market for the private sector, providing further information on the capacity of local private sector providers to provide cold chain maintenance. The in country studies were used to inform on common best practices in successful private sector CCE maintenance strategies[8].

3.4.1. Key Findings

- Successful CCE maintenance strategies within the private sector were found to share certain key features:
  - An **international stakeholder** who supports the supply of both critical and non-critical parts
  - A **provincial hub**, where spares are supplied and skilled technical knowledge is available, specific to electronics and refrigeration
  - A **local technician presence**, either employed or contracted by the organization, who has access to small and medium spares and is able to communicate with the regional hub for advanced support on larger repairs
    - An important factor further affecting technical presence is the critical effect of ongoing investment in the education of in-country technical staff on the successful long term maintenance of CCE

- Further strategies, systems and processes were identified, which enable strengthening of the CCE maintenance capacity:
  - **One preferred supplier:** Contracting one in-country supplier to perform CCE maintenance and have responsibility for spare parts
  - **Build relationships:** Facilitating essential relationships with international stakeholders and local technicians, leveraging the crucial capacity of skills and parts at the regional hub level

[8] *See Output Toolkit: Private Sector Best Practice*

- **Local and regional collaboration:** Accessing skills, equipment and logistics networks already available at the regional level, enabling receipt of parts from international sources as well as increasing the local knowledge base through training programs
- **Leveraging country relationships:** Leveraging existing logistical networks with neighbouring countries, such as Lumbashi which has associated links with Zambia and South Africa, while north-eastern regions have associated links with Uganda.
- **Engage public sector:** ensuring payments are made punctually or working with funders to support CCE maintenance

- Consideration should also extend to support installed technology and the capacity to strengthen and improve the CCE maintenance model through:
  - Supporting local skills development to manage and operate CCE, identifying critical points in CCE operation with guidance on trouble shooting and preventing failure
  - Establishing methodologies to record and review the cost of ownership of the CCE in use
  - Monitoring performance of service providers, including their ability to innovate and drive effective equipment maintenance
  - Ensuring that a "provide and walk away" approach is absent from the core of any initiative

For full analysis, please refer to **Section 4, *CCE Maintenance Country Landscape*** document.

4. Toolkit

Following a landscape analysis across countries and sectors, the results of the study were used to develop three major tools for use by Gavi and Gavi-supported countries:

4.1. Cold Chain Equipment (CCE) Maintenance Guide

The purpose of the document is to guide countries on how to determine the best choices for cold chain equipment maintenance services and how best to manage these services. It aims to inform country decision makers, who are either planning to procure CCE or who have already installed CCE, on their choices for maintenance and how to engage those options[9].

- The guide defines the major options, advantages and disadvantages identified in the following maintenance models:
  - Insourced
  - Outsourced
  - Hybrid

- The guide also describes the following CCE maintenance approaches[10]:
  - Curative
  - Preventative

[9] *See Annex 2*

[10] *See Annex 2*

- Predictive

- Risk and Asset Management are also described as they form key tools which should be used during the CCE maintenance decision making process

For full CCE Maintenance Guide, please refer to ***CCE Maintenance Guidelines*** **document**.

4.2. Costing Model Framework

The framework aims to help countries more accurately determine the lifetime costs of different types of CCE and to aid in planning and budgeting. It complements the PATH Total Cost to Ownership Model ("TCO Tool v1 0 2 DRAFT for TechNet 17112015").

- In its current format, the TCO Model does not include detailed cost considerations regarding the implementation of maintenance systems for procured CCE. Examples of unit costs which it does not contain include:
  - Hourly wage of cold chain technician
  - Average travel costs for onsite repairs
  - Average annual travel costs to obtain fuel
  - Average travel costs for technicians
  - Average transport cost of equipment
- These unit costs are important in determining a high-level estimate for maintenance. Depending on the design and implementation of a maintenance system, costs could vary significantly and this level is not required for the scope of the TCO tool's purposes
- Thus, while the tool provides analysis for decisions on CCE election and/or procurement specifications, there is a need for a follow-on plan with a costed framework, specifically for a CCE management and maintenance system.
- Nevertheless, the TCO model is the only tool currently identified that is widely available to collate and analyse such detail when estimating costs for equipment ownership.

For full CCE costing model framework, please refer to ***CCE Maintenance Costing*** **document**.

4.3. Private Sector Best Practice for CCE Maintenance

The study researched the preconditions in place for the engagement of the private sector in support of public health initiatives. The study team sought to comprehend the models for the deployment of maintenance management of cold chain and related equipment across multiple industries in the private sector.

- The following table summarizes the case studies examined:

Industry	Healthcare Sector	Non Healthcare Sector
Mining	Kenieba Health Centre	Mining Equipment
Healthcare	The Biovac Institute (TBI) and Litha Healthcare Imperial Health Sciences	
Catering & Hospitality		ATS Group
Retail		Imperial Fast 'n Fresh, South Africa Star Bazaar, India
Non Healthcare, Non Cold Chain Equipment		Mining: Randgold Resources – Mine Equipment Maintenance
Retail Cold Chain Equipment Manufacturer/ Agent	Samsung and Zero Appliances	

- Five West African[11] countries across multiple industries were also reviewed, providing insight into the status of equipment maintenance in the region. The final study carried out was relevant to the local and multinational manufacturers/agents providing spare parts
- The findings from in country visits and case study reviews provide a high level overview of the marketplace, identifying the achievements and challenges encountered by cross-sector organizations

For full analysis, please refer to ***CCE Maintenance for Case Studies for Marketplace Analysis*** and ***CCE Maintenance Country Landscape*** documents.

5. Further Recommendations for Gavi Alliance and Secretariat

In the near future, the demand for vaccines is expected to continue rising, with storage requirements increasing accordingly. Currently, this is predicted to occur in an environment facing challenges in terms of the availability of skills, spare parts and transition to new technologies. The establishment of disciplined approaches, supporting standardized systems and processes, will be fundamental to enabling the necessary improvements in cold chain maintenance.

As Gavi embarks on leveraging the Cold Chain Equipment Optimisation Platform within countries, we recommend strengthening the project by:

- Presenting Gavi-eligible countries with the key findings and considerations of the present study, including tools developed
- Establishing a framework for CCE Optimisation Platform technical assistance in order to leverage the aligned tool set to support the country in implementing a maturity assessment

[11] *See Section 8*

- Performing a follow-up review of a sample of countries who have implemented CCE aligned with Gavi recommendations in order to determine if costs of ownership, service and efficiencies are successfully being managed
- Where new technologies are being introduced, it would be beneficial to ensure planning, management and implementation of a phased approach. Current CCE resources (both internal and external) require technical training to understand the different maintenance approaches between current and new technologies (e.g. mechanical vs. solar powered CCE).
- Similarly, strengthening and improving education of basic refrigerator operation, identifying critical points in the operation and providing guidance on troubleshooting and internal measures to prevent failure
- Working with in country CCE maintenance companies in order to establish a relationship with WHO PQS accredited suppliers (typically based in Europe or South Africa), potentially allowing them to become the preferred service providers for new technology in remote sites.
- Ensure that maintenance budgets are being “ring-fenced” and so are not able to be diverted to other activities.

6. Acknowledgements

The passion, commitment and technical skills of the people that have provided input into this project was indeed a privilege to witness. Those who provided the “boots on the ground” in the African focused countries, with its inherent language barriers and travel challenges, deserve a special mention for the contribution they have made with the provision of valuable information and data. A big thank you to the organizations and individuals who willingly made the time to meet, discuss and provide information. This shows the importance of the subject matter.
To the “backroom” staff, we acknowledge your contribution and valuable support provided during the “stressful days” of this project (did we ever have a day with no stress?).

We would like to take this opportunity to thank the members of the Gavi Private Sector Working Group (PSWG) for their guidance.

We sincerely hope that this report and its associated reports (four in the series) give the required information, guidance and data which will enable organizations to understand the CCE challenges being faced by countries within the public and private sectors of healthcare and commercial sectors of varying industries within Africa.

7. Abbreviations

CCE	Cold Chain Equipment
EPI	Expanded Programme on Immunization
KPI	Key Performance Indicator
MMS	Maintenance Management System
MOH	Ministry of Health

SLA	Service Level Agreement
SOPs	Standard Operating Procedures
TCO	Total Cost of Ownership

8. Country List

The following list provides the countries examined across the study.

8.1. Country Landscape – In Country Visits

- Democratic Republic of Congo (Rangold Resources, Samsung)
- Malawi (Samsung)
- Kenya (Samsung)

8.2. Case Studies

- South Africa (The Biovac Institute & Litha Healthcare, Imperial Health Sciences, ATS Group, Imperial Fast 'n Fresh, Samsung, Zero Appliances, Thermo King/GEA, Transicold)
- Mali (Kenieba Health Centre, Rangold Resources Limited)
- Ivory Coast (Rangold Resources)
- Liberia
- Senegal
- Guinea

9. References

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Annexes

Annex 1 – Example of Good Practice CCE Approach 15
ATS Group – South Africa – Non Healthcare Sector 15
Annex 2 – Maintenance Models and Types 16

Annex 1 – Example of Good Practice CCE Approach

ATS Group – South Africa – Non Healthcare Sector

Overview

ATS has operated catering and hospitality services in Africa since 1996. The ATS group of companies includes subsidiaries in Burkina Faso, Cote d' Ivoire, Ghana, Liberia, Mali, Nigeria, Sierra Leone, Tanzania, Zambia, Guinea, Mozambique and the DRC. This group of companies now employs over 4 000 personnel and it is catering for over 55 000 people daily, with regional offices in each location.

Due to the nature of catering, ATS has an extensive cold chain, with transporting and storing of perishables. A focus on the cold chain equipment as well as the maintenance thereof is prioritized, to ensure uninterrupted services to clients.

Equipment

Equipment ranges from industrial to domestic refrigeration. 40' reefers are used to transport frozen foods to site locations. Reefers are split between freezers and chillers, depending on the specific requirement. To maintain the cold chain, reefers are always plugged in, and technical staff that are transporting the reefer will continuously monitor the temperature along the supply chain.

At sites there would typically be a combination of reefers both for frozen and chilled food respectively, and domestic fridges for the day-to-day catering requirements. At Kibali mine site, in the northeast DRC, reefer freezers store the frozen food, which is then moved to reefer chillers for thawing and defrosting on a daily basis for the chef's menu. Once taken from the chillers, there are domestic fridges that are used daily for items that are to be cooked.

Equipment maintenance approach

ATS focuses on both preventative and breakdown maintenance:

- Preventative maintenance is based on schedules to monitor temperatures and the physical condition of the reefers. If maintained and cleaned regularly, the reefers have an indefinite lifespan. These checks are aided by sensors, probes and monitors that provide feedback to the staff on the current performance of the equipment.
- At ATS's mine sites such as Kibali mine in northeast DRC, the chef will do a manual check of the temperature every two hours, to ensure the required conditions are being maintained. If there is any discrepancy, technicians are alerted immediately.

Spare parts

ATS will keep stock of critical items should a failure occur. Such parts are:

- PC boards
- Thermostats
- Compressors
- Elements
- Sensors

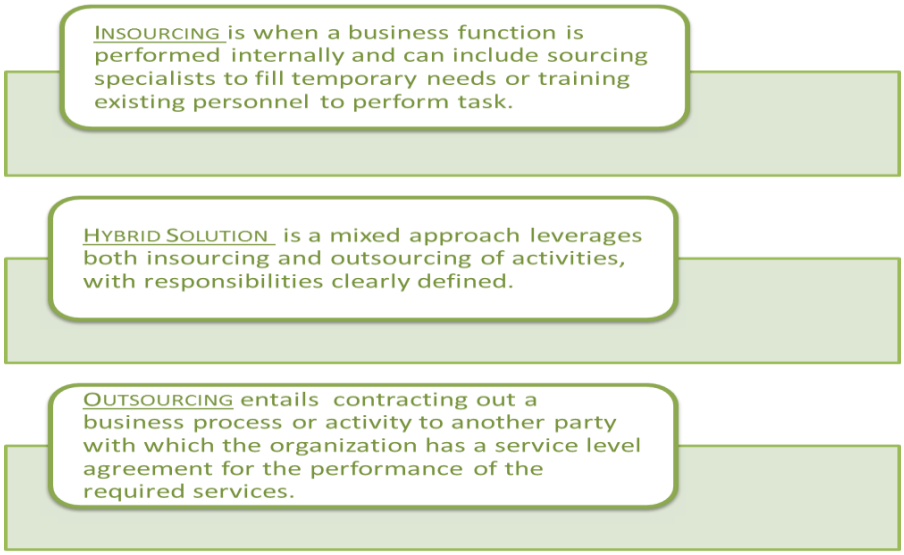
All items are sourced in-country. Local partners and leveraged, but where this is not possible, items will be imported from either RSA or the UK. Should the item be extremely urgent, ATS has a well-developed logistics system to get the item to site within three days.

Skills

With Ghana being a regional hub for ATS, there are 27 technicians employed on a full time basis. In other counties there are generally two technicians. In terms of skills, ATS hires local people and trains them to their standards, with the only exception being for gas installations, which would require certified artisans as
Per HSE regulations. There is a focus on involving local business, creating jobs or using in-country suppliers where possible.
Skills are insourced for the installation and maintenance of equipment.

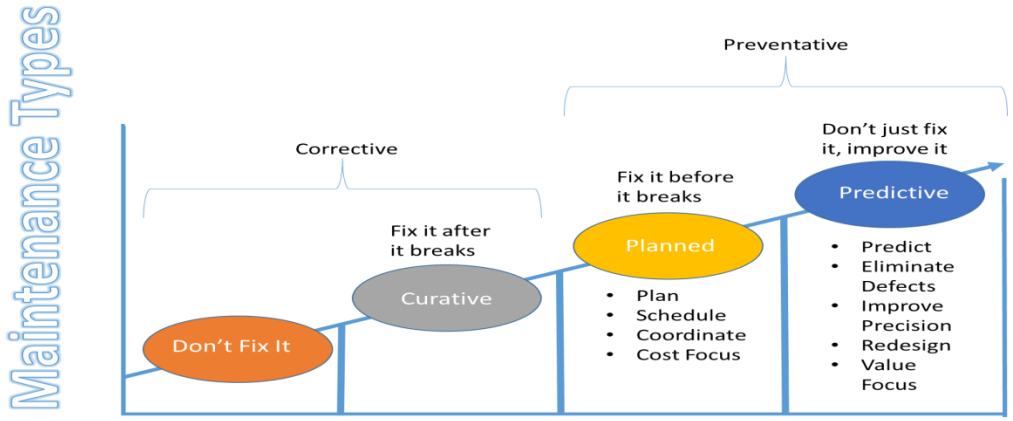
Annex 2 – Maintenance Models and Types

Maintenance Models



1. **Insourced,**
2. **Outsourced,**
3. **Hybrid (combination of both above)**.

Maintenance Types



1. **Curative,**
2. **Preventative and,**
3. **Predictive**