



## FIG Working Week 2013

6–10 May, Abuja, Nigeria

“Environment for Sustainability”

Production Asset Protection Using GIS and Remote Sensing Techniques; the Shell Nigeria Experience.

(6663)

By



**Bola Lasisi**, Chika Onwuteaka & Abimbola Olumuyiwa – Nigeria.

Shell Petroleum Development Company of Nigeria Limited,

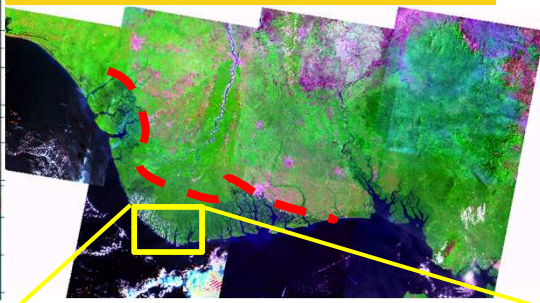
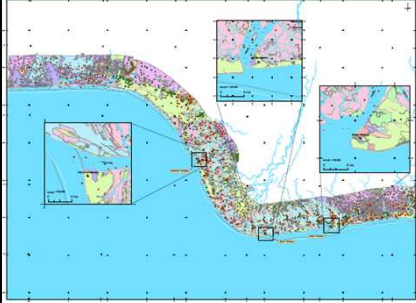
Port Harcourt.

Nigeria

### SCOPE OF THE PAPER

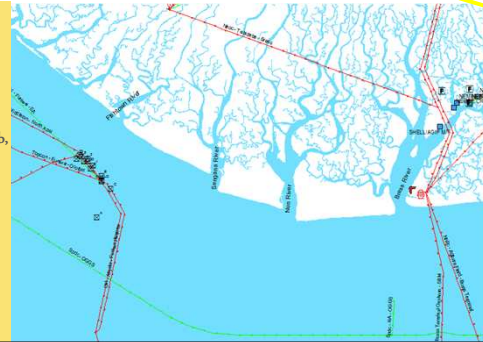
- Introduction: Production assets and Niger Delta terrain overview
- Key threats to hydro carbon production facilities.
- Why is Shell concerned?
- Crude Theft: Environmental, health, safety, security, social, economics, etc consequences.
- Assets' vulnerabilities and challenges.
- Efforts at asset protection & GI technical apps deployment.
- Facilities right of way (RoW) encroachment quantification, analysis & follow up actions.
- Conclusion & recommendations.

## INTRODUCTION: NIGER DELTA TERRAIN OVERVIEW

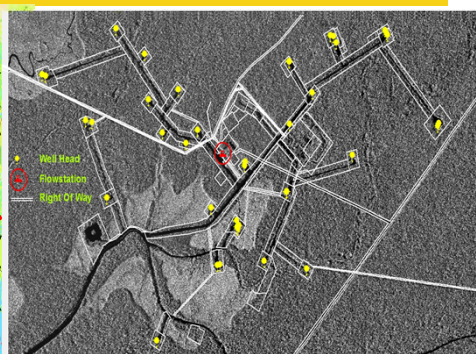


### Key Statistics

- Coastline of >900km – Lagos to Bakassi.
- Highly undulating galloping swamp terrain.
- Diverse vegetation of Low/high mangrove forest, raffia palm trees, shrub, etc.
- Complex and numerous network of rivers, creeks and creeklets.
- Complex & sensitive ecosystem with vast variety of flora and fauna.

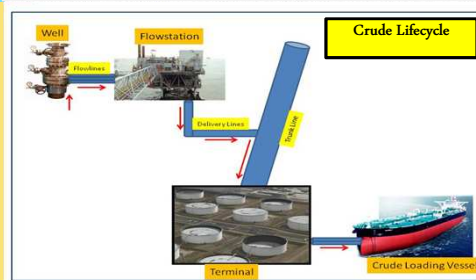


## INTRODUCTION: PRODUCTION ASSETS IN THE NIGER DELTA



### Key Statistics

- > 6000km of minor/major Oil & Gas P/lines
- 5000+ wellheads
- >200 Production Facilities; F/stns, Compressor Stns, Gas plants etc.
- Ca.150 Manifolds



## MAIN THREATS TO THE OIL & GAS FACILITIES

Sabotage

Crude theft

Encroachment



Environmental degradation, pollution,  
ozone layer depletion & revenue loss.

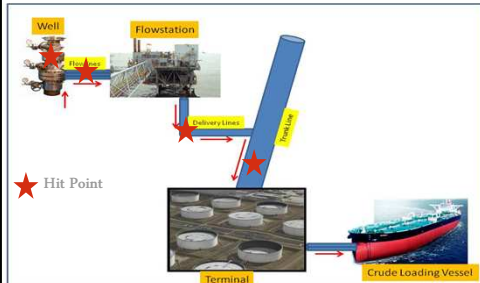
## WHY IS SHELL CONCERNED? SABOTAGE

### Consequences

- Threat/loss of lives.
- Damage to production facilities.
- Environmental destruction.
- Pollution/health challenges.
- Revenue losses: Repairs, replacement, deferment, etc
- Destruction of aquatic lives/farms & social impacts.

**CRUDE THEFT: COMMONLY CALLED "BUNKERING" IN NIGERIA**

■ Criminal evacuation of HC from a production facility to an illegal destination.



- Vulnerable Hit Points:**
- Well heads
  - Flow lines
  - Delivery lines
  - Trunk lines.
- Dimension:** Local and international



**EVACUATION CONTAINERS: VARIOUS SIZES, TYPES & MAKES**



WHY IS SHELL CONCERNED? CRUDE THEFT IMPLICATIONS - 1



All vices associated with sabotage are applicable.



Revenue loss to the nation & operators. *“...stolen crude oil stood at about 400,000 barrels a day in April last year, which equals 17 per cent of national production...”* ..... Finance Minister, Ngozi Okonjo-Iweala, Financial Times, June 26, 2012.



Fire incidents & attendant loss of lives & assets.

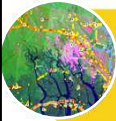


Severe environmental & ecological destruction. *“...SPDC may be forced to close a major pipeline, as Shell loses around 60,000 barrels each day”* .....Shell MD, NTA March 4, 2013.

WHY IS SHELL CONCERNED? CRUDE THEFT IMPLICATIONS - 2



National value erosion: children & youths can easily be misled.



Shortened infrastructure lifespan.



Surface and ground water pollution.



Frequent sea pollution

**APPLICATION OF GEO-INFO IN ASSET PROTECTION BY SPDC**

**Established**

**Process**

- Robust process in place for mapping & managing all spill related incidents – statutory.
- Spill impact is classified by terrain, ownership & intensity of impact.
- Map & attributes archived & integrated on GIS

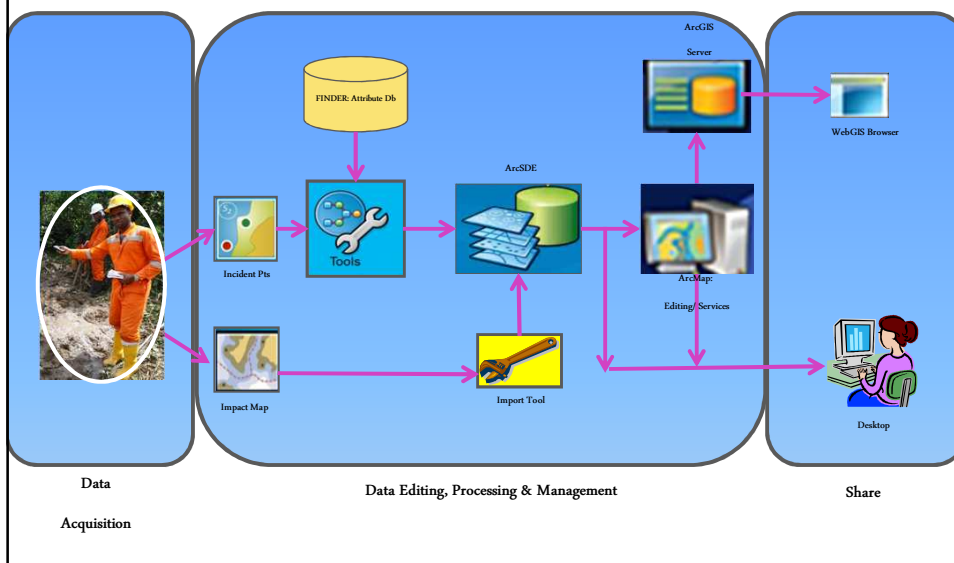
**2010 Efforts**

- GIS based geo-processing heat-map
- WebGIS developed for focused counter surveillance.

**2012 Efforts**

- Focused waypoint route maps created for 14 major pipelines.
- GPS Cameras used for geo-tagged snap-shuts of suspected illegal bunkering/refining points.
- Point maps with attributes created on GIS.
- Heat maps created for focused surveillance.

**APPLICATION OF GEO-INFO: ESTABLISHED PROCESS WORKFLOW**



**APPLICATION OF GEO-INFORMATION: SPILL/BUNKERING PTS GIS MAPS**

**Spill Pts**

**Sabotage/Theft Pts - Cause of >90% Spills.**

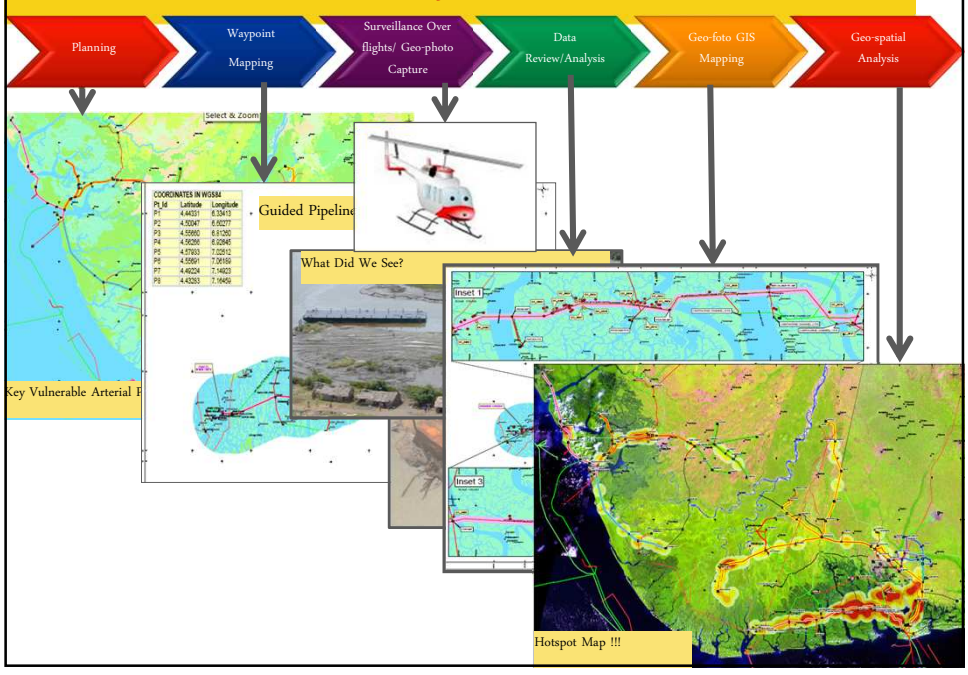
**2010 Heat Map: Instrumental to Focused Surveillance & Facilities Protection**

**Spill Point Attributes**

- Every Spill Pt Completes with Associated Attribute Information – for Robust Geo-spatial Analysis

ID	Name	Location	Attribute
SPILL_001	...	...	...
SPILL_002	...	...	...
SPILL_003	...	...	...
SPILL_004	...	...	...
SPILL_005	...	...	...
SPILL_006	...	...	...
SPILL_007	...	...	...
SPILL_008	...	...	...
SPILL_009	...	...	...
SPILL_010	...	...	...

**APPLICATION OF GEO-INFO: 2012 – 2013 MAJOR P/L SURVEILLANCE**



## WHY IS SHELL CONCERNED? ENCROACHMENT

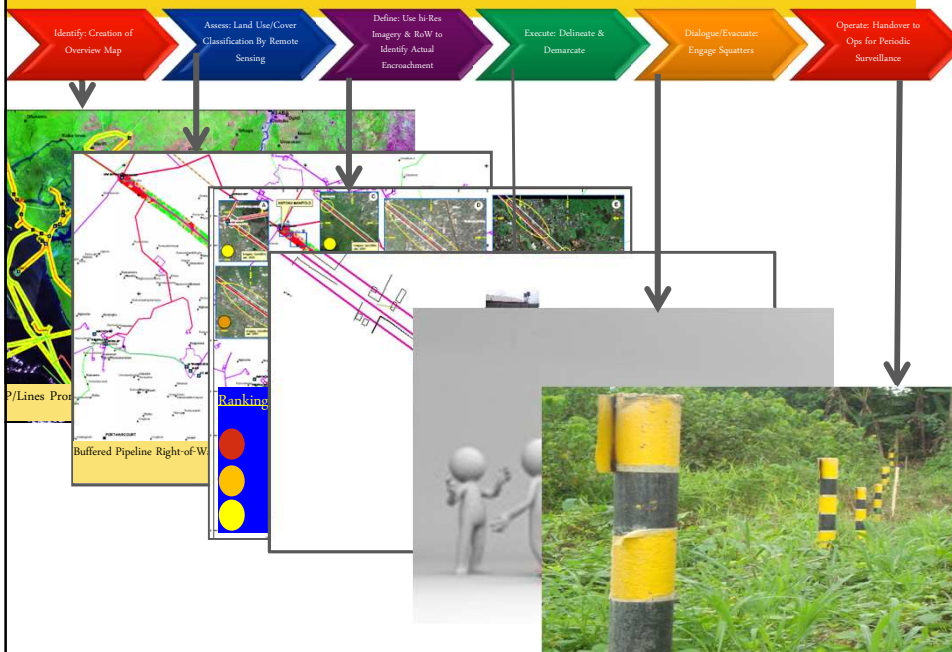
### Types or Why?

- Comfort seeking squatters
- Speculative squatters
- Unsuspecting buyer
- Improvised public utilities
- Criminal intentions

### Consequences

- Risk of accidental damage.
- Risk to lives & properties.
- Environmental destruction.
- Obstacles to facilities' maintenance & Isolation in an emergency.
- Loss of crude, assets & revenue.

## APPLICATION OF GEO-INFO: ENCROACHMENT MAPPING





## APPLICATION OF GEO-INFO: BENEFITS

- Reduction of personnel exposure.
- Most of the work are done in-house with available expertise, data, software tools and hardware.
- Mitigating efforts for crude theft & encroachment were more focused.
- Rapid turnaround encroachment & crude theft analysis.
- Very significant cost saving when compared with other options.
- Periodic trend analysis possible since data on GIS are re-usable.

## OUR CHALLENGES & LIMITATIONS

- Managing expectations; demand for GI apps in SPDC beyond available resources.
- Accurate encroachment mapping requires up-to-date metre/sub-metre optical satellite imagery; this is constrained by cloud cover in the Niger Delta region.
- Crude theft and other criminal activities against HC facilities not abating.

*.... crude oil theft still impacts on the Nigerian economy irrespective of successes recorded in minimizing their occurrences .... Mrs. Diezani Alison-Madueke, Minister of Petroleum Resources (This Day newspaper, March 12 2013).*

## CONCLUSION & RECOMMENDATION

Surveying and Geo-informatics are in regular demand at every phase of hydrocarbon search and development - > 80% of E&P assets have spatial component.

Advancements in GIS, remote sensing and computing power (hard & software) have further grown the application & value of GI in recent times in geometrical progression.

Applications of GI today, are limited ONLY by skills, creativity and capacity of practitioners in one hand and resources (Budget) made available by policy makers.

As in the above examples, effective use of GI and collaboration with allied professionals will continue to add tremendous values, visibility and worth of GI practitioners.

However, it is worth noting, that the protection of oil & gas facilities and preservation of our fragile environment go beyond technology solutions – all hands MUST be on the deck.

## ACKNOWLEDGEMENT

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- **Nedo Osayande** - General Mgr, Sustainable Development & Community Relations.
- Ramesh Chennareddy – formerly Senior GIS Analyst, SPDC, Port Harcourt , Nigeria

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Thank you !!!



**SCOPE FOR FURTHER GI APPLICATION, BUT NOT IN SCOPE**

- Use of Remote Sensing techniques for change detection and analysis of environmental impacts of third party interference on oil & gas production facilities in the Niger Delta.