

**Abdulkadir Kabir****PROJECT-TECHNOLOGICAL APPROACH TO SOLVE THE CRUDE OIL THEFT, SABOTAGE AND PIPELINE VANDALIZATION PROBLEM IN NIGERIA**

It is shown main tendency of the problem of the crude oil theft, sabotage and pipeline vandalization in Nigeria nowadays: it did not disappear but on the contrary has the tendency to increase during recent few years, thus remains actual in the context of the National economy, social and political life of people. The project-technological approach is proposed to organize monitoring of the particular territory with drones considering drones routes as projects, and their combination as a dynamic project portfolio. The approach is aimed to provide most effective and safe monitoring, saving money and time to get completed information about monitoring objects if to compare it with other technical and technological approaches and devices. Fig. 1, tabl. 6, ref. 51.

Key words: oil theft, sabotage, pipeline vandalization, losses, project management, project, portfolio, monitoring, drone.

**Problem statement.** No doubt that oil theft, sabotage and pipeline vandalization (if to combine them together in one big and wide problem) is the most essential challenge for the Nigerian society and economy nowadays. But talking of that theft, sabotage and pipeline vandalization (TSV) problem we consider also other relating activities such as facilities or installations in form of illegal bunkering, fuel scooping, illegal refining, etc.

Main location of this problem is the Niger Delta region from the time when crude oil and natural gas were discovered there in 1956. Today oil producing states of this region currently made up of nine states including Abia, Akwa Ibom, Edo, Imo, Ondo, Rivers, Bayelsa, Delta States, Lagos State.

As one can read in [1], "Oil theft is carried out at different levels and quantities; hence there are various methods in which oil theft operations are carried out in the Niger Delta. The most popular method for stealing the crude oil is to puncture the pipeline conveying the product from one point to the other and tap it at the point where it had been punctured or ruptured [2]. According to Asuni [3]; Katsouris and Sayne [4] there are three operational methods of illegal bunkering and oil theft in the Niger Delta. These are: a minor and small-scale pilfering of condensate and petroleum product destined local market; direct hacking into pipelines or tapping with a hose from wellhead through practical removal of the 'Christmas tree'; and excess lifting of crude oil beyond the licensed amount, using forged bills of lading. While the first is less significant in that it is conducted by local people who hide under the cover of violence in the Niger Delta region, the second category brings more technical sophistication into the business with the stolen product placed in small barges and taken straight into the sea where it is loaded into larger barges (mother ships) in return for money and weapons used to fuel violence, while the last category speaks solely about a spoilt system facilitated by official corruption in that it involves the use of forged bills of lading, "issued by a carrier to a shipper, listing and acknowledging receipt of goods for transport and specifying terms of delivery" [1, p. 565]. The scale of TSV problem is huge considering oil and gas losses, quantity of people involved, consequences on the environment pollution and degradation, great negative impact on the national economy, social standards, the country image as a member of OPEC and world oil and gas market player, and other aspects.

TSV problem in Nigeria is articulated and discussed among local communities, politicians, officials, representatives of market players, national and international organizations at different levels in different forms in the practical context. Besides a lot of researches are devoted to find out reliable conclusions about appropriate reasons, factors, parties involved, interrelations between facts, impacts, unsolved issues and challenges, etc. We can group them by several directions:

1) studies of oil sector in relation to national policy, economy, development and social standards, national debt and place in OPEC [5-12];

2) studies collecting reliable statistics about losses [13-18];

3) studies revealing reasons that lead to such phenomenon (psychological, political, others) [19-21];

4) studies that conclude attempts made to reduce the problem (such as amnesty of 2009 for instance), formulate lessons learned and possible rational prospects for future [22-25].

All mentioned studies reflect retrospective complex approach to analyze facts and data. Basing on their conclusions it is expedient to apply more system and holistic vision within project management approach. To our mind it can give a direction to propose solution to the TSV problem.

**Purpose of the study** is to ground conceptual solution to get this TSV problem solved within the project management approach. In this context we have to answer three following research questions:

1. What is the modern state and main tendency of the TSV problem nowadays?

2. How is it possible to apply project management approach?

**Findings.** Leaving apart historical ground, social, psychological, cultural, political and other factors, characteristics of the oil producing states population, we focused to collect definite available facts about losses as a result of TSV problem. Let's consider them below, based on numeric sources.

"SPDC admitted in its Briefs in 1995 and later in 2004, that it "recorded an average of 221 spills per year since 1989 in its operational areas. This involved a total of 7,350 barrels of oil a year". 50 percent of spills are due to corrosion of aging facilities mostly flow lines; 21 percent happens in the course of operations to produce oil; and the remaining 29 percent is due to sabotage. From the analysis, the quantity of spills "supposedly" from sabotage - militants, constitutes a small proportion of the total spills in the region."

"Nigeria loses N174 billion to pipeline vandals in the past ten years in over 16,083 pipeline breaks. Barkindo, Sanusi, Group Managing Director of Nigeria's NNPC made the assertion, and supported it with graphic details. The amount is much more than what the federal government has so far spent on the Niger Delta since 1956 when oil was discovered in the region".

"In a recent study on oil spills, it was stated that it occurs in the Niger Delta with such a frequency that between 1976 and 1990, the industry had 2,676 cases. This rose to 7,253 cases in 2003; and 9,640 cases in 2008. The loss from spills in 2006, alone was 4,892,644 barrels. The said study further revealed that MNOCs, especially SPDC have not demonstrated significant commitment to mitigate the effects of oil spills".

"The Nigerian National Petroleum Corporation (NNPC), a Federal Government owned oil empire, reported in 2005 that the 20 MNOCs operating in the country spilled 2,300 cubic meters of oil in 300 separate incidences annually. It is, however, safe to argue that due to under reporting, the actual figure would be much higher than this conservative estimate they presented. As it we knew, after five years (i.e., 2010), the same NNPC provided graphic details of the activities of pipeline vandalization and

contents that 97.5 percent of the ugly incidences are due to sabotage by Niger Delta militants”.

“The economic loss to the Nigerian State and the MNOCs are staggering. According to London’s Financial Time, the estimated loss between 1996 and 2004, alone was US\$4 billion yearly while 500 people died monthly within the period. This created so much tension that it increased the global price of crude oil to US\$50 per barrel in 2004, and US\$110 per barrel in May, 2008. Furthermore, the protracted crisis has embarrassed Nigeria as an unsafe and nudging the international community. Thus, in September 2006, 21 Ambassadors from the European Union visited the then Nigerian President, Chief Olusegun Obasanjo, in Abuja and expressed their concern over the upsurge of violence in the Niger Delta, and the slow pace of the Federal Government in addressing the problems”.

“Table 1 below shows that between 2003 and 2007 there were 2,572,600 barrels of spills, estimated at N 2,860,170,000. It should be emphasized that the socio-economic consequences highlighted at Table 1 is just a tip of the ice-berg because the total spills of 2.9 billion barrels is mainly from the sketchy statistics of spills we have stated since only SPDC, Mobil, Chevron-Texaco and alone within the period 2003 to 2007. We visited Bassambiri, Sangakiri, Ijawkiri and Alafamokiri in Nembe Kingdom in Nembe LGA in Bayelsa State during the field work in October 2007. The visit was an eye opener to the enormous quantitative and non-quantitative cost of oil spills resulting from pipelines vandalization in Nembe Kingdom.

Table 1

**Selected cases of economic consequences of oil pipelines vandalization in Niger Delta, 2003-2007**

S/N	Date of Vandalization	Name of MNOG & Location of Facility	Duration of the Damage	Qty of Crude Oil	Average Prize (N)	Amount (N,000)
1	May 3, 2003	Mobil Producing Nig. Unltd, Eket, Akwa Ibom State	60 days	Massive Spill thro Bayelsa, Rivers and A/ibom	-	1,163,210
2	May 18, 2003	Shell Petro. Dev. Coy. Warri Area, Delta State	38 days	120,000 Barrels	N29.20	133,150
3	August 20 – 30, 2003	SPDC, Egwa, I&I flow stations at Azuzuzuama, Batan, Opa-Krushu, Ogbotobo and Odidi I&I, Delta and Bayelsa	10 days	500,000	N29.20	146,000
4	November 20, 2003	SPDC, Forcado Terminal, Delta State	14 days	604,500	N29.20	247,120
5	January 10, 2004	Chevron Nig. Ltd. Macaraba & Aotonana Ogbe-ljoh, Delta State	20 days	100,000	N38.73	77,460
6	March 9, 2004	Nigeria, Agip Oil Coy. Ltd. (NAOC) Sagbama, Foropa & Nembe, Bayelsa	28 days	105,000	N38.73	113,870
7	September 20, 2004	SPDC 15 flow stations in Bonny and Burutu in Rivers and Delta	60 days	98,450	N38.73	228,880

Continuation of tabl. 1

8	January 3, 2005	NAOC, Nembe Creeks in Warri, Delta	10 days	120,000	N55.43	66,520
9	February 10, 2005	Chevron, Escravos, Delta	8 days	400,000	N55.43	177,380
10	February 10, 2006	SPDC, Chenomi Creeks in Warri, Delta	5 days	180,000	N65.71	59,140
11	June 8, 2006	SPDC, Oporoma, Bayelsa	15 days	145,100	N65.71	143,020
12	March 20, 2007	SPDC, Abiieye & Olero, Delta	20 days	200,000	N76.13	304,520

Source: [26, 27].

The data shows that between 1997 and 2006 alone, SPDC and NAOC had over 809,153 barrels of oil spills (Table 2) that caused serious health hazards. The spills destroyed aquatic lives and adversely affected the fishing occupation of the communities. When the people applied for compensation it was delayed for three years, and even the amount was too small to resettle the people who had lost their sources of livelihood. They, therefore, feel that the total losses to SPDC and NAOC, amounting to N27.609, billion stated in Table 2 is still not commensurate to the pains the spills have caused them. The economic loss to the Nigerian State and the MNOCs are staggering. According to London's Financial Time, the estimated loss between 1996 and 2004, alone was US\$4 billion yearly while 500 people died monthly within the period. This created so much tension that it increased the global price of crude oil to US\$50 per barrel in 2004, and US\$110 per barrel in May, 2008. Furthermore, the protracted crisis has embarrassed Nigeria as an unsafe and nudging the international community. Thus, in September 2006, 21 Ambassadors from the European Union visited the then Nigerian President, Chief Olusegun Obasanjo, in Abuja and expressed their concern over the upsurge of violence in the Niger Delta, and the slow pace of the Federal Government in addressing the problems.

Table 2

#### Oil Spills at SPDC and NAOC Installations at Nembe, 1997-2006 (Summary)

Year	Locations	Total Number	Numbers of Barrels per day	MNOC	Average price per Barrel (N)	Amount put together (N000)
1997-2009	Nembe Creek 1,2,3	490	644,171	Btw NAOC, SPDC,	Btw 18.71-65.71	24,240,899
1997-2009	Odeama Creek	91	123,863	NAOC	Btw 18.71-65.71	2,774,231
1997-2009	Diebu Creek	28	41,300	SPDC	16.80	993,890

Sources: [28-30].

Relevant available data is presented in tables 3-6, fig.1.

"Shell Petroleum Development Company (SPDC) in early 2012, "raised the alarm concerning heightened oil theft activities on its Nembe Creek Trunkline (NCTL). Shell estimated conservatively that 140,000 barrels of crude oil valued at \$16 million was being stolen daily.

In 2 May 2012, SPDC shut down the Nembe Creek Trunk Line (NCTL) due to "incessant crude theft activities". On 13th May 2014, "two six inches lines" through

which oil was being stolen from the pipeline was disconnected. In December 2011, barely one year after the line was commissioned, the pipeline was "shut down for one month to repair leaks caused by crude thieves."

Table 3

**Summary of reported oil spill, 2011**

Cause of spillage	Number of incidents		Volume spilled (bbis)
	onshore	offshore	onshore/ offshore
Sabotage/Vandalism	27	0	1432.34
Equipment failure	13	10	184.33
Operational error	1	1	26.41
Mystery spills	1	3	NA
Corrosion	2	3	9.8
TOTAL	43	16	1628.88

Table 4

**Losses of revenue due to militants activities**

Year	Amount of loss, US dollars (\$)
2006	\$27,220,320,000
2007	\$18,805,362,000
2008	\$20,270,842,000

Source: [31].

Table 5

**Losses due to theft**

Year	Barrel N, million
2010	2,316,281
2011	6,391,310
2012	3,045,624

Source: [31].

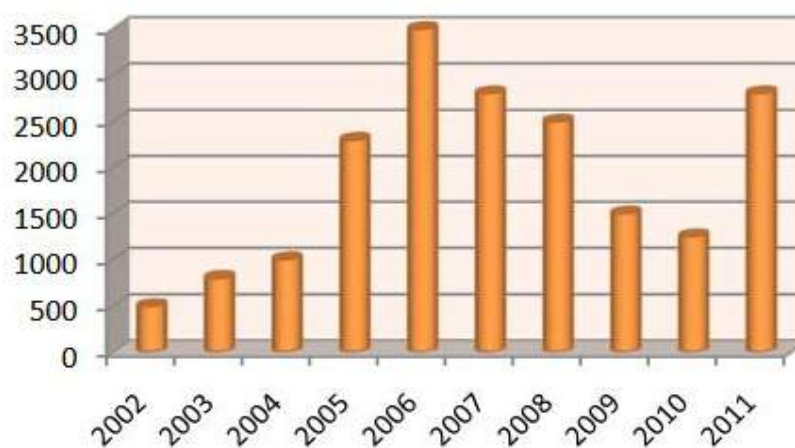


Fig. 1. Incidence of oil spill in the Niger Delta (2002 – 2011)

Source: [32].

### Pipeline incidences in Nigeria

Year	Incidences	Value loss, million
2009	1453	8,195
2010	836	6,848.11
2011	2768	12,526
2012	2230	21484

Source: [33].

Oil theft on the NCTL significantly impacted on Shells exportation of the Bonny Light. On 4 May 2012, Shell Petroleum Development Company of Nigeria Ltd (SPDC) was compelled by "production deferment caused by incessant crude theft and illegal bunkering on NCTL" to declare force majeure on outstanding cargoes of Bonny Light."

"The integrity of the old Nembe Creek Pipeline which Nembe Creek Trunk Line (NCTL) replaced, was severally weakened by "crude theft points' that oil thieves installed on the pipeline. Within two years of the new Nembe Creek Trunk Line (NCTL) being commissioned into use, it has been "repeatedly targeted by crude thieves, requiring that SPDC must now shut down sections of the line to allow the removal of illegal bunkering points."

"An increase of pipeline vandalism and oil theft in the last four years has cost Nigeria an estimated daily loss of hundreds of thousands of barrels of crude oil and much more unspecified quantities of refined petroleum products. According to reports from the Nigerian National Petroleum Corporation (NNPC) and the Nigeria Extractive Industries Transparency Initiative (NEITI), it was disclosed that the country may have lost a staggering sum of N8.6 trillion in the last four years to the criminal activities of pipeline vandals in the industry.

On the average, N2.4 trillion was stolen every year since 2012. Coming as sources close to the management of NEITI said due to poor record keeping at the NNPC and other relevant authorities in Nigeria, it has become almost impossible to get data on the loses at the snap of the fingers, but a former Managing Director of NNPC, Mr. Andrew Yakubu, put the yearly loss of revenue at \$12 billion (about N2.4 trillion) yearly. On her part, the former Minister of Finance, Dr. Ngozi Okonjo-Iweala, at a time, put the quantity of crude oil lost daily at 400,000 barrels per day while one of the Joint Venture Operators estimated the loss to be between 150,000 and 180,000 barrels per day.

The crude oil stolen from broached pipelines and illegally refined products are regularly smuggled out and sold on the lucrative black market. Meanwhile, NNPC in its latest annual statistical bulletin said it recorded 3,700 cases of petroleum products pipeline broaching in 2014 alone, leading to \$300 million annual revenue loss".

"Oil theft has been identified as the biggest threat to Nigeria's economy. Its socio-economic impacts include environmental degradation, loss of economic activities for the communities, loss of revenues to the government resulting in inadequate funding for development initiatives, increased criminality in Niger Delta region, lack of security due to illegal activities and infiltration of international collaborator and bad image for the country [34]. As a result of crude oil theft, maintenance of oil terminals and declaration of force majeure, the money shared by the three tiers of government in Nigeria in 2013 was erratic. In the first quarter of 2013 alone, Nigeria lost about N191 billion (\$1.23 billion) due to drop in crude oil production, arising from incessant crude oil theft and vandalism along the major pipelines within the Niger Delta, the Nigerian National Petroleum Corporation (NNPC) disclosed. Daily crude oil production during the period fluctuated between 2.1 and 2.3 million barrels per day (mbpd) compared

with the projected estimate of 2.48mbpd. Expectedly, the fall between actual production and forecast in first quarter of 2013 resulted in a drop in crude oil revenue of about \$1.23 billion (N191 billion) that should have accrued to the Federation Account [35].

Also, due to the loss of oil revenue to the oil thieves, Nigeria can no longer export crude oil above two million barrels per day as opposed to budgetary provision of 2.5 million barrels per day [36]. Nigeria is no longer selling enough crude oil to meet budgetary provisions. The government is failing to meet some of its obligation and domestic debt is rising rapidly. For instance, the country targeted, according to its financial plans for the year 2013, 2.53 million barrels per day production, a projection it failed to meet due to oil theft. Ogbefun [37] noted that the negative impacts of vandalism and crude oil theft include the destruction of aquatic and farmlands, economic sabotage which explains the shortfall of Nigeria's 2014 budget from \$29.3 billion in 2013 to \$23.3 billion in 2014 and divestments by some International Oil Companies, IOCs, with attendant job losses thereby compounding the unemployment situation in Nigeria. The colossal loss of revenue to oil theft was succinctly captured by [38]. He aptly stated that: "Over the past 3 to 6 years, in particular since the commencement of the presidential Amnesty programme for the Niger Delta, the subsequent inducement of a reduction in armed militancy in the region, and the consequent rise in the incidences of crude oil theft, we have been told by the highest responsible authorities (NNPC, Ministers of Finance and Petroleum Resources, CBN Governor etc) that the country has been losing outrageous quantities of crude oil to oil theft and pipeline vandalism. In 2009 and 2010, the figures claimed ranged from 100,000 barrels per day to 200,000 barrels per day of crude oil. By 2012 this figure had risen to between 200,000 and 300,000 barrels per day of crude oil and now the figure given for 2013 is 400,000 barrels per day of crude oil lost to oil theft. This represent between 20% and 25% of our total daily production capacity of between 2 and 2.5 million barrels per day of crude oil. It also amount to an annual revenue losses of about \$14 billion i.e., N2.24 trillion, that is almost half (50%) of the annual federal government budget. This is a colossal loss by any standards".

"The Nigerian National Petroleum Corporation (NNPC) also disclosed that the federal government lost over \$11billion (about N1.72trillion) worth of oil revenue in 2013. The former group managing director of the corporation, Andrew Yakubu, who gave the figure, attributed the loss to incessant attacks on major pipelines and crude oil theft in the Niger Delta [39]. Similarly, the Coordinating Minister of the Economy and Minister of Finance, Mrs. Ngozi Okonjo-Iweala said that in 2013 crude oil theft and associated deferred production was estimated at over 300,000bpd. This costs the Nigerian government some \$12 billion annually in terms of deferred production revenues and the cost of pipeline repairs [40]. Although, these figures of oil theft and illegal bunkering are not premised on any empirically verifiable statistics of Nigeria's oil production, nevertheless the figures are mindboggling. Despite the different estimates quoted by different authorities, what we can draw is that the volume of stolen oil in the Niger Delta region of Nigeria is enormous and these have significant adverse impact on socio-economic development of Nigeria.

According to the NNPC, incidents of pipeline vandalism rose by 4.54 per cent in 2014, compared to the situation in the preceding year. "A total of 3,732 line breaks was reported on NNPC pipelines out of which 3,700 was as a result of vandalism, while 32 cases were due to system deterioration," it said.

Major oil operators, including Anglo-Dutch oil giant, Shell, have blamed repeated oil thefts and sabotage of key pipelines as the major cause of spills and pollution in the southern oil-producing region".

*"NNPC: How Much Nigeria Loses To Pipeline Vandalism, 2014 [41]:*

- The corporation stated that “a total of 3,732 line breaks was reported on NNPC pipelines out of which 3,700 was as a result of vandalism, while 32 cases were due to system deterioration resulting in a loss of 355.69 thousand metric tonnes of petroleum products worth about N44.75 billion. Also 1.08 million barrels of crude oil worth about N14.847 billion was lost in the same period. There were 32 cases of fire incidents during the year under review.”

- Further breaking the crude oil loss down, the company disclosed that the country lost 17,964 barrels of Bonny Light valued at N264.37 million, while 586,776 barrels of Escravos Light valued at N8.636 billion was lost to pipeline vandalism in the period under review.

- In the same vein, the activities of the pipeline vandals led to the loss of 341,566 barrels of Ughelli Blend valued at N5.027 billion while 62,499 barrels of Seplat blend valued at N919 million was lost in 2014.

- Besides these, the report revealed that pipeline vandalism in the Port Harcourt network, led to the loss 7,460 metric tonnes of petroleum products valued at N958.72 million; Warri lost 14,290 metric tonnes valued at N2.312 billion, while Mosimi lost 332,850 metric tonnes valued at N41.279 billion

- Pipeline vandalism did not leave Kaduna out as this led to the loss of 1,080 metric tonnes valued at N200.39 million”.

*“The list of attacks by the Niger Delta Avengers so far in the 2016:*

- *Wednesday, February 10, 2016.* The Niger Delta Avengers claimed responsibility for the Bonny Soku Export Gas line attack. The same day, the group said it was responsible for previous attacks in the region for the past few weeks (The Agip Brass crude oil pipelines in Bayelsa State, Escravos-Warri crude oil pipeline, Escravos-Lagos- Abuja gas pipeline, Alero Dibi Abiteye crude oil pipeline and also, the Escravos -Abiteye gas line)

- *Saturday, February 13, 2016* NDA blew up a major export line being operated by the Shell Petroleum Development Company of Nigeria (SPDC)

- *Friday, February 19, 2016* Avengers Strike Team 6 – one of the numerous strike teams of the Niger Delta Avengers around the region – blew up the Clough Creek Tebidaba Agip Pipeline Manifold in Bayelsa State

- *Wednesday, May 4, 2016,* Niger Delta Avengers said it had blown up the Chevron valve platform. The Avengers claimed the platform is the most significant platform for Chevron because it is the main connecting point linking other platforms and it is also a fulcrum to Chevron’s Blow Out Preventer (BOP) and the Chevron tank farm.

- *Thursday, May 5, 2016,* The Avengers group wrote on its website that the group’s Strike Team 4 hit the Nigerian National Petroleum Corporation (NNPC) crude and gas lines.

- *Thursday, May 5, 2016,* Strike Team 7 of the Niger Delta Avengers blew up Well D25 in Abiteye belonging to Chevron.

- *Saturday, May 21, 2016,* NDA group blew up Nembe 1, 2 and 3 Brass to Bonny Trunk Line belonging to Agip and Shell.

- *Wednesday, May 25, 2016,* NDAvengers just blew up the Escravos tank farm Main Electricity Feed PipeLine” the NDA group posted on its page

- *Thursday, May 26, 2016,* NDA group blew up another #NNPC Gas and Crude trunkline close to Warri despite the presence of the Military guarding the facility.

- *Tuesday, May 31, 2016,* The Avengers said despite the heavy presence of 100 Gunboats, 4 Warships and Jet Bombers, they blew up Chevron Oil Well RMP 23 and RMP 24.



- *Thursday, June 2, 2016*, At about 2:00am today @NDAvengers blew up the Ogboinbiri to Tebidaba and Clough Creek to Tebidaba Crude Oil pipelines in Bayelsa State” the Avengers claimed on its Twitter page.

- *Thursday, June 2, 2016*, The Avengers blew up the SPDC forcados 48” Export line. The reason given by the Avengers for the attack was that they warned SPDC not to go ahead with repair works but they refused.

- *Friday, June 3, 2016*, The NDA group said it blew up the Obi Obi Brass Trunk line belonging to Agip ENI. The Avengers claimed it is Agip’s major crude oil line in Bayelsa State.

- *Thursday, June 16, 2016*, The group claimed responsibility for the attack on the Nigerian National Petroleum Corporation (NNPC) pipeline in Oruk Anam Local Government Area in Akwa Ibom”.

All these data prove the crucial scale of the TSV problem for Nigerian economy, environment, and society. The reason is that Nigeria is a mono-economy, largely depending on the oil sector where oil is being savagely stolen in copious quantities on daily basis. This negative trend is really ugly. One can notice persistent increase of oil theft activities in the Niger Delta in recent times. According to [1], “statistics of oil theft among major oil-producing countries (Indonesia, Russia, Iraq and Mexico) shows that Nigeria is losing as much as 400,000 barrels of oil per day which equates to losses of US\$1.7 billion a month. This is huge loss compared to a total theft of 5,000 to 10,000 barrels per day and just 2,000 to 3,000 barrels per day in Mexico and Indonesia respectively”.

Many studies concluded that numeric attempts and huge investments of public funds on the safety of oil facilities have not yielded the required results. All researchers admit the enthroned corruption by Nigerian elites, high level of youth unemployment, institutional decay and dysfunctions, poor governance, ineffective and corrupt law enforcement agencies, international crime collaborations and others as essential reasons. This allows proposing some recommendations and underlining need for multidimensional approach and concerted efforts from the Government side.

Such multidimensional approach is presented by project management approach (or methodology) [42]. Following its basic principles, there should be several alternatives to solve the same problem.

Understanding of essence, parties involved, historical background, causes and factors, operational mechanisms of the TSV problem, in combination with system and project approach allows to articulate at least three alternatives for its solution:

- to keep existing system of owning/controlling pipelines and responsibility (MNOC), but fulfil all actual social-economic needs of local communities;
- to keep existing system of owning/controlling pipelines and responsibility (MNOC), but provide guaranteed strong protection of pipelines in technical aspect;
- to change existing system of owning/controlling pipelines and responsibility, overturning it to local communities.

Alternative related to technical protection of pipelines now is articulated actively among experts and politicians in Nigeria. It is supported by a range of existing technologies and appropriate technical devices developed to maintain needs of the oil industry technically. Definite foreign and indigenous firms operating in the Nigerian oil and gas industry have plans “to install electronic surveillance gadgets on their facilities in a bid to curb the vandalism of oil installations across the country. This was one of the highlights of conclusions at a two-day stakeholders’ consultation on the draft National Gas Policy and National Oil Policy, which ended in Abuja. Giving an overview of the NOP, the Senior Technical Adviser on Upstream and Gas to the Minister of State for Petroleum Resources, Mr. Gbite Adeniji, stated that it was important for companies to start putting in place oil field security systems. Adeniji, while explaining

the difference between the draft NOP and the bill before the National Assembly, stated that the vandalism of pipelines had severely impacted the sector negatively.

The Group Managing Director, Nigerian National Petroleum Corporation, Dr. Maikanti Baru, recently stated that the country had witnessed about 1,000 cases of pipeline vandalism since the beginning of this year, a development that he noted had dragged down crude oil. The NNPC, in its latest financial and operations report, also stated that in July and August this year, the country recorded 311 and 221 cases of vandalism of oil pipelines, respectively. Speaking on oil field security as contained in the draft NOP, Adeniji said: "Oil companies are to be charged with electronic surveillance. The time is overdue for Nigeria to build a digital oil field." He noted that in a few days' time, the final policy document would be ready and when approved, the NOP would be binding on all players in the oil and gas sector. He added that the NGP and NOP would be transparent and ensure that things were done properly. Adeniji stated that the policy would also ensure that Nigeria gets a proper metering system that would eradicate oil theft in the industry. He said the restructuring of the NNPC, as contained in the draft document, would guarantee the clarity required for the disbursements that must be made into the Federation Account, adding that it would avoid subsidies being constrained financially and stop overlapping roles with regulatory agencies. Chairing the panel discussion, Tim Okon, an industry expert, stated that Nigeria should be moving away from crude oil production and export to production and processing. Another panellist, Mr. Isa Baba, said the policy should support the deregulation of pipelines, stressing that the vandalism of oil installations was becoming alarming despite the ongoing negotiations between the government and agitators in the Niger Delta. He said, "It is sad that vandalism is this much in Nigeria today. We should deregulate the pipelines and either makes the security of the facilities the responsibility of host communities or some particular security outfits," he said" [43].

According to Nigeria's minister of power Professor Chinedu Nebo, "Nigeria records the highest number of vandalized oil pipelines in the world, making it harder to achieve sustainable power supply. "Online news media reports that, Nigeria loses about 150 thousand barrels of crude oil per day to pipeline vandalism, which at the average price of \$43 per barrel at the time amounted to the tune of about \$6.5 million a day. At 6 million dollars a day loss, this would add up to \$42 million dollars a week and \$2.18 billion dollars a year in lost oil revenue. Mind you this is at a low price per barrel of just \$43. Imagine how much the country loses when the oil prices improve. And all this loss is attributable to vandalization and criminal breach in a highly technological age? A wireless age? For a country as technologically savvy as Nigeria, the issue of malicious pipeline leakage or "bunkering" should have ceased to come up for discussion a long time ago. We live today in a wireless world full of sensors and highly sensitive surveillance devices. The same way distance and time is no more an excuse in the exchange of mail with the advent of email, location and distance is no more an excuse in allowing pipeline bunkering to continue to exist. Technologies like Fiber Optic Distributed Acoustic Sensing (DAS) are intelligent solutions that can detect and classify third party interference.

These devices actually prevent incidents before they occur and are equipped with wireless technology and GPS to pinpoint the exact point of interference. The fiber-optic cables act as highly sensitive microphones and can detect even a man walking on the surface of the ground. They can be used for existing as well as new piping networks; coupled with a system of cameras and sensors Nigeria can make her pipeline systems absolutely theft-proof. Considering the degree of dependence of the entire oil industry on connecting pipelines; from upstream to downstream, it is

imperative that the government make this technology a priority for the sake of the entire economy.

Excuses like “oh well it’s so expensive” can no longer hold water seeing that the country is already losing over \$2 billion dollars yearly in pipeline vandalism and theft related activities. This technology would definitively not cost over a billion dollars but would create huge economic dividends for years to come, yielding billions of dollars in profits. Bear in mind that in the process of cleaning up this dirty business of bunkering, scavenger industries that have benefited from this anomaly for umpteenth years would have to give way. The improvement in electric supply created by the protection of these pipelines would affect the power generator importers not to mention the billion dollar crude pipeline bunkering business. All these leach-like black-market industries would vanish overnight, simply by the application of available technology. It’s high time the Nigerian government took the bull by the horns in terms of the oil industry while the global demand for crude is still relevant; for with improvements in technology, clean energy sources may power cars and a host of other things in the near future. Before Turnaround maintenance, expansions or any other large project is carried out with Nigeria’s refineries, the connecting pipeline network, upon which the entire system rests, should first be secured; because the energy sector, and the oil industry and indeed the entire economy depends on the functionality of these piping networks” [44].

Seven billion a year - that's the estimated cost in dollars of oil stolen from pipes in the Niger Delta, according to the International Energy Agency. Over the past decade, more than 15,000 breaks have been attributed to pipeline vandals. Nigeria has experienced a phenomenal rise in cases. According to the Nigerian National Petroleum Corporation (NNPC), in 1995, there were just seven reported incidents; between 2010 and 2012 the figure stood at 2,787. Amid a background of political tension, abject poverty and rampant militancy, a vandalism epidemic has embraced Nigeria and oil pipelines are the target. "The theft is very material," says Simon Henry, CFO of Shell. "Figures have been quoted of up to a billion dollars a month being stolen from the government, in effect, and that figure is probably accurate." Despite being Africa's largest oil-producing country, a well-documented shortage in petroleum has left citizens angry at a perceived corruption and mismanagement by officials, not to mention rising oil prices. Exploiting the situation, organized crime syndicates are paying groups to break into oil facilities and steal thousands of gallons in each raid, while militants use pipeline vandalism to make political statements against apparent aggressive corporate profiteering and elicit governments within the sector. For those in absolute poverty, taking advantage of poorly protected pipes in areas of low policing could be the difference between having light and power, and not. Even in areas with substantial policing, forces are struggling to contain the crisis, with two officers reportedly taken hostage and others killed during a recent shoot-out next to a pipeline in Arepo, Ogun, just one example of the humanitarian impact this surge in vandalism is having. It's a regrettably familiar story; in May this year, a deliberate explosion in Port Harcourt, Nigeria's 210,000bpd-capacity refinery, killed seven and injured many more. Such is the extent of the problem that Shell last year announced its intentions to sell its stake in its Nembe Creek pipeline. Mutiu Sunmonu, head of Shell's Nigerian unit, called the level of vandalism unprecedented, stating: "More than 60,000 barrels of oil are being stolen a day, resulting in frequent production shutdowns and massive oil spills blighting the ecosystem. Such a figure represents a significant chunk of the 150,000bpd production from the 97km network. Shell shut down the entire pipeline earlier this year in order to remove theft points, a move that meant further lost profits; cementing its desire to leave the region.

The obvious tactic has been to bolster security forces across the Niger Delta, where vandalism is most prevalent. In a recent report from Platform, a London-based body monitoring the oil and gas industry, Shell spent nearly \$1 billion on worldwide security between 2007 and 2009, 40% of which was allocated to the protection of its resources and personnel in Nigeria, understandable when you consider that 62 employees were kidnapped and three killed, and 15-20% of its output was stolen during 2008".

"Protecting our people and our assets is Shell's highest priority," says spokesperson Precious Okolobo. "Our spending on security is carefully judged to meet this objective, wherever we operate in the world. We have always acknowledged the difficulties of working in countries like Nigeria. In the period that this report refers to, the armed militancy in the Niger Delta was at its height, requiring a relatively high level of security spending there."

Despite this huge outlay, there is a growing realisation that a robust security force cannot stop vandalism on its own. The primary aim of the investment has been directed at protecting workers, and with pipelines spanning hundreds of kilometres, preventing and monitoring vandalism without enlisting technology has proved ineffective at stemming breakages.

The act of cutting into lines with hacksaws and blowtorches, installing spigots and siphoning off some of the crude flow, is regionally known as 'bunkering' and among the most common acts of vandalism to pipes. When systems are laid in shallow ground, less than 2ft in the case of the Arepo line, they are easily accessible and bunkering becomes a simpler process.

Recognising the current limitations of its infrastructure, NNPC has committed to deploying horizontal directional drilling (HDD) technology in all of its pipelines. HDD, or slant drilling, is the practice of installing underground pipes without the need to dig trenches, as pipes are pulled along a prescribed bore path made through surface-launched drilling rigs. Not only does the technique mitigate many of the social and environmental impacts of installing pipelines, compared with the 'open-cut' method, it also means pipes can be placed up to 60m below the surface.

"We have changed the configuration of the pipelines and, once you change the configuration, it has to be new pipes because the old ones cannot go through the configuration," says Andrew Yakubu, group managing director of NNPC. "This HDD is a new technology that keeps the pipelines far away from the surface. That is what the contractors are doing and that is what we mean by bringing a new technology to bear. Certainly, they are going to bury the pipelines very deep, beyond anybody's access." The cost of pipe replacement, speed of installation and the fact this technology was relatively unknown meant initial uptake was slow, made worse by local communities agitated by construction and the perceived consequences. However, after numerous projects were completed successfully, ahead of schedule and without fault, many more oil companies are turning to HDD as a move against pipeline vandalism.

Though deeper pipelines thwart the less-equipped vandals, there are still many groups that possess the technological means to extract oil from them. In order to respond to these attacks immediately, firms have tried installing discrete sensors in especially contentious areas. However, the scope of these is limited and covering entire pipelines is impractical.

Recent developments have seen the creation of fibre-optic cable (FOC) systems; a cost-effective way of tracing structural and functional integrity across huge distances. Buried above the pipeline, FOCs use laser technology to scout for intrusions and tampering of pipes, relaying signals back to the designated control room upon detection.

One of the huge advantages of such cabling is its ability to update security and maintenance teams with 24-hour real-time information such as the exact location of physical damages. Providing these groups can coordinate effective response units to the area, the loss of oil through spillage and bunkering can be stemmed a lot quicker.

The supervisory control and data acquisition (SCADA) systems operate in a similar vein. Operating through a network of remote terminal units (RTU) and a central host computer, they gather information such as where pipeline leaks occur, and transfer data back to the central site and alert the station, providing detailed analysis and taking the necessary automated actions on the way. Control of the network is managed from a single remote location, while the field devices used monitor variables such as flow, pressure and temperature across the pipeline; when anomalies are discovered, the data is relayed to the automatic control system that has the power to perform emergency shut-down of valves if a breach has occurred.

It has proved itself an effective platform for tracking vandalism and limiting the economic consequences already in Nigeria and David Ige, NNPC group executive director, is keen to see more uptake of the platform. "We are looking at technology like SCADA to minimise our response time and know exactly where the pipeline vandalism is taking place," he says. "We have been maintaining for over 30 years and, despite the difficult environment characterised by frequent vandalism, we have managed to keep the lines at a high level of availability." More than 70% of Nigeria's exports are made up of crude petroleum and reducing the \$7-billion loss of oil is in the best interests of the international community. "Oil theft is an aspect of global terrorism that has become a big industry on its own. It has become a major threat to the Nigerian economy and we need to work with all stakeholders to curb it. The thieves must be traced, apprehended and prosecuted," said Nigerian President Goodluck Jonathan in a statement delivered at The Hague. Jonathan has set aside \$1 billion to bolster pipeline security and infrastructure, resolve community-related issues, and encourage oil companies to follow through with their corporate social responsibility. Whether this will be enough to stem what has become a hugely profitable black market industry remains to be seen.

Many security and technological measures have already been implemented to stop oil pipeline vandalism and detect leakages and failure in oil pipelines but due to obvious human factor none of these wonderful measures and technologies had yielded the desired results.

In [45] the design is presented to enable oil pipeline and plant operators monitor the safety of oil pipelines installed remotely (especially oil pipelines above the ground and buried underneath). This proposed system should be able to detect an intrusion into the pipeline system early enough and alert the pipeline operators via SMS and email before the pipeline is vandalized and also be able to capture a video/photo footage of the vandalism scene in case the vandals go ahead to vandalize the pipelines to steal crude oil. This will go a long way in reducing the theft of pipeline products, environmental degradation and also accidental deaths which often result from the explosion of those flammable substances when leakage occurs.

Among other methods we can consider Hardware Sub-System [46]. The design and development of the system has both hardware and software requirements. The hardware subsystems include the hardware modules used to realize the physical test-bed for the oil pipeline vandalism surveillance and monitoring system. The software sub-systems include the software modules used to realize the sensor initializations and communication, data transfers from the deployed test-bed to an online FTP Server, designated email addresses, and mobile phone numbers, data visualization from the FTP Server to web-based SCADA Server and clients at the Control room of the IOC so that the personnel of the IOC can view videos/photos captured from a

vandalisation scene at the oil pipeline infrastructure. Among this direction there are others systems created by technicians.

Another direction is drone as advanced unmanned aircraft or ship that can navigate autonomously, without human control or beyond the line of sight. It can be equipped with a variety of additional equipment, including cameras, GPS guided missiles, Global Positioning Systems (GPS), navigation systems, sensors, and so on. Due to this pipelines can be checked by drones, as well as drones are able to help coordinate a variety of security operations, and can preserve evidence alike.

By today there is an experience in using drones for pipelines monitoring aims. From [47] it is known that global energy companies like Shell, British Petroleum and ConocoPhillips employing the services of drone surveillance in monitoring and checking wells at extreme underwater depths for deep water oil platforms in the Gulf of Mexico. Recently, Iraqi oil minister Abdel-Karim Luaibi said that Baghdad had given priority to protection of oil facilities and operators, thus it has made ready drones to start flying over the Basra region. He said two drones were ready to start monitoring the skies over Basra "to provide a clearer picture of the southern oilfields and energy installations... This is the first time Iraq is using drones to fly over the energy installations the south" [45]. In Colombia, the military, which is working with private security forces hired by oil companies to conduct surveillance on oil producing infrastructure, has also purchased more than a half-dozen surveillance drones.

Plagued by frequent pipeline vandalism, Nigeria may well have to consider the use of drones. "All over the world, drones are used to monitor pipelines combined with the application of smart technology. All that is required is for someone to administer the control from a remote location while the droves monitor the pipelines," Taiwo Oyedele, head of tax, PwC, said [48].

Last year, the Nigerian Security and Civil Defence Corps (NSCDC) announced that it was deploying 500 drones and aircraft to monitor pipelines and other oil installations to protect them against militant attacks. In March this year, Abubakar Rabe, director of defence information, said the Nigerian National Petroleum Corporation (NNPC) was working with the Nigerian Air Force to deploy the drones: "The issue of drone, the air component of the air force, which is primarily under the control of the defence headquarters, is working round the clock. They are coming up with strategies in liaison with NNPC to know how best they could process the drones if need be," he said in an interview.

While the military authorities take their time setting up the drones, Nigeria's over 50,000 pipelines, traversing the length of 6,000 kilometres remain susceptible to militant attacks. In this context, Ohi Alegbe, Group General Manager, Group Public Affairs Division, NNPC, confirmed that the deployment of drones would not commence immediately due to its high technicality; he however did not clarify if NAEC would secure the facilities. But he noted that the NNPC had received assurances from the country's defence chief that the Army would secure the pipelines. When asked if drones had been deployed to monitor the oil installations, he said, "No, nothing like that. Working out the whole thing is not one you can say will happen over the weekend or during the week. It is a lot more technical than that. You have to involve the airforce. You have to involve some other partners who are outside of the country. It is a high security issue and is not something that can just take effect quickly like that. We are doing this thing in collaboration with the office of the CDS. Further updates shall be communicated to you on this matter."

The official, who spoke on condition of anonymity, said, "The first phase of intervention for the protection of pipelines took effect last weekend and the office of the Chief of Defence Staff has assured us that they are going to deploy the Army Engineering Corps over the weekend. This, therefore, implies that the Army is taking

over the protection of pipelines and all other security agencies are going to work with them from the flanks. He said on the issue of drone that “we should know that we cannot get these highly technical gadgets so cheaply. So, we may say that the deployment of drones will be a medium to long term plan and not an immediate action. For the immediate, it is the change in the guard of those who are securing the pipelines that has been effected. Now, the Army Engineering Corps is taking over. That is what has been achieved and is what has been done at this moment.”

As we can conclude, most of existing technologies and devices are aimed to control oil infrastructure in conditions of “standard” mode of operating. But in Nigeria there is a special aggressive environment – militants who act bravely and are unpredictable in their attacks. They are good organized and equipped with modern weapon. Their attitude to attempts of government to install drones as monitoring and protecting means is known, as they say: “your drones will not stop us” [49].

If to return to solution of the TSV problem in Nigeria, we do not insist on any alternative we mentioned above, as well as we do not discuss their merits and demerits. The only thing we want to underline here is that any alternative requires technical support in a form of special systems that allow to check, fix, monitor state of pipelines and nearest spaces.

As we had searched from sources existing technologies and devices have special technical advantages and disadvantages. Their common feature is that being high-technological and thus expensive enough; they are so unprotected before militants and their weapons. Thus, there should be absolutely alternative technological and technical approach. It can take essential time to develop such approach. In short perspective absolutely alternative organizational approach supported by existing technologies and devices can be developed basing on the project approach. Let’s discuss such approach in terms of using drones for the pipelines monitoring and controlling purposes for the limited territory.

In this context each flight of each drone we plan to consider as a project – in general understanding is a special temporary activity aimed at creating a product with unique properties, that delivers values to stakeholders within their missions [50]. Such considering gives possibility to use project portfolio approach [51] and to manage drones’ flights basing at nontraditional manner, but as a dynamic project portfolio with the dynamic placement of drones. Main task of this dynamic portfolio is to provide the completed information about the state of pipelines within defined monitoring territory, save money and time to get it. This information is expected to be transferred immediately to security units involved in the pipeline protection activities so that a proactive action such as shutting down the pipeline valves or calling in the security patrol team can be initiated to mitigate loss. The major benefits of this study include early detection of pipeline intrusion before pipeline is damaged which can lead to reduction in financial losses and alleviation of environmental degradation as well as the possibility of the system to take action towards successful arrest and prosecution of the culprits by a way of capturing the vandalisation video footage which can serve as exhibit in the court of law.

Configuration of the portfolio is unique for particular moment of time and should provide completed information about the monitoring zone. Each project is the flight route caused by range of factors including ability to provide required information within the portfolio, technological issues (weight, distance and height of the flight, field of vision, etc.). Such dynamic project portfolio needs special soft management, supported by special map that combines physical, pipelines, airports, militants’ roads and others; classification and details about attacks, frequency and classification of damages, etc.

**Conclusions and directions for further research.** There is a great need of permanent solution to TSV problem in Nigeria thereby increase oil production and improve the economy of Nigeria. The technical focus of the work should be leaned towards successful usage of drones as most developed devices that would not only monitor from meters away of potential danger, but can equally be used to target the vandals and locate their hideouts. But using such high technological and expensive devices requires special managerial theoretical base within project management approach. Main idea to use dynamic project portfolio model to organize effective and efficient routes of drones should be supported by further findings related to how to form and renew such portfolio, to check them by economic calculations considering physical and technical features of routes.

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## МНОГОСЛОЙНОСТЬ И ГИБРИДНОСТЬ В МЯГКОМ УПРАВЛЕНИИ РИСКАМИ ПРОЕКТА

Разработаны концептуальные модели проектной организации, категорий-элементов системной модели окружения проекта. Выявлены контекстные различия употребления терминов «probability» и «likelihood». Проанализированы тенденции использования подходов управления знаниями и бизнес-разведки в управлении проектами. Исследован принцип применения коэффициентов RQ (Risk Intelligence Quotient) и RQ (Rationality Quotient). Рис. 8, табл. 5, ист. 43.

Ключевые слова: риск, неопределенность, управление, проект, мягкость, вероятность, правдоподобность, не-фактор, многослойность, гибридность.

JEL O22

**Постановка проблемы в общем виде и ее связь с важными практическими и научными задачами.** На сегодняшний день существует множество руководств, стандартов, пособий, подходов, разного рода научных и практических публикаций по управлению рисками в общем, и по управлению рисками проектов в частности. Большинство известных способов предлагают управлять рисками при помощи пошагового процесса (обычно 5-10 шагов) и относят навыки управления рисками к техническим компетенциям, а подходы к управлению рисками принято считать стандартизированными, т.е. жесткими. Однако не все реализуемые проекты являются успешными, а, значит, есть