Geographic Information Systems (GIS) a tool for Transportation Infrastructure Planning in Ghana

> A case study to the Dept. of Feeder Roads

> > By Stephen Yao Fiatornu GEO-TECH SYSTEMS LTD.,

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1.0

2.0

Introduction

Many development projects have serious dependence on transport network. Authentic information on the transport infrastructure is fundamental requirement for many decision making process; therefore information is required to be reliable, updated, relevant, easily accessible and affordable.

This demand for information requires new approaches in which data related to transportation network should be identified, collected, stored, retrieved, managed, analyzed, communicated and presented. The road transport related data in particular involves activities like traffic counting, sign inventories, accident investigation, recording of construction and maintenance projects and funding, right of way surveys, bridge inventories, pavement condition surveys, geometry design inventories, and other data collection and maintenance activities.

1.1 Initial problems faced without GIS

The database that existed before did not allow the user

- 1/ to manipulate, access and query the database other than in a very limited way
- 2/ is limited to textual queries only
- 3/ cannot select and view attribute data with respect to spatial and topological relationship
- 4/ cannot access related data such as land use, population, and the road network characteristics of the area in the crossing vicinity.

A case study to DFR

- Road network in Ghana is more than 50,000km of road length
- The planning and management of such a huge network in the country has been primarily done at three levels
- About 13,367km of Trunk Roads
- About 4,029km of Urban Roads

• And about 32,600km of Feeder Roads

| ROAD SYSTEM OF | ' GHANA |
|--------------------------|-------------|
| TRUNK ROADS | Length (Km) |
| Rigid Pavement | 38 |
| Asphalt Surfaced | 1,566 |
| Bituninous Surfaced | 4,733 |
| Gravel | 6.357 |
| Missing Links | |
| Total | 13,367 |
| | |
| URB AN ROADS | Length (Km) |
| Asphalt Surfaced | 427 |
| Bituninous Surfaced | 1,496 |
| Gravel | 2,106 |
| Total | 4,029 |
| | |
| FEEDER ROADS | Length (Km) |
| Gravel | 32,600 |
| Total | 32,600 |
| | |
| TOTAL LENCTH OF NETWORK | 49.996 |
| TOTAL IMPOSITOR VEHICORY | 151556 |





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| NON-ENGINEERED RO. | AD | INV | ΈN | TO | RY | | _ | | | | | | | | | | | | | DE | PA | RT | ME | NT | OF | FE | ED | ER | RO | ADS |
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Old DFR Road Inventory form format

Field Survey

Prior to the survey on the field, we had thorough field reconnaissance on the collection attributes data. These were the forms we came out with:

- Structures Survey Form SS1
- Road Survey Form RS1

4.1

• GPS Survey (to generate node and road table)

4.1.1 Road Survey (Attributes) Form RS1

- Columns (Fields)
- 1. Date
- 2. District code.
- 3. Road id.
- 4. Start Node Name
- 5. End Node Name
- 6. Start Chainage (km+m)
- 7. End Chainage (km+m)
- 8. Functional Class I/C/A

| | Ele Elet Ven Josef Figmet Tools Gate Wriden Heb Adoge FOF Type a sustain for heb | |
|-----------------------------|--|-------|
| 9. Engineering Class E/P/N | □ 22 4 3 (3) (3) (3) (3) (3) (3) (3) (3) (3) (| - 4 |
| | | |
| 10. Road Width (m) | F8 • S Salven | |
| | A B C D E F G H I J K L M N O P | P Q |
| 11 Pavement P/II | 1 DATE: REG DIST ROAD_NO START NODE END_NODE START_CHAN END_CHAINA START_CHAI END_CHAIN[FU EN ROA PAV S_U TO | JP RC |
| 11. Lavement 170 | Z 14/2/05 ASH OPF OFFO01 Bensus Junctic Sandyem 0.0000 1.000 0.000 33011 E 6.3 U 6 K | 0 |
| | 4 14/2/05 ASH OFF OFFOI Bonus Juncis Sandreem 2.000 3.000 6552.000 69921 k 6.5 U G M | G |
| 12. Surface unpaved K/G/S/G | 5 14/2/05 ASH OFF OFF001 Bonsus Junctic Bankyem 3.000 4.000 9842.000 13123 I E 6.3 U G R | G |
| 1 | 6 14/2/05 ASH OFF OFF001 Bonsua Junctic Sankyem 4.000 5.000 13123.000 16404 I E 6.3 U G R | G |
| 13 Side Drains L/U | 7 14/2/05 ASH OFF OFF001 Bonaua Junctic Sankyem 5.000 6.000 16404.000 19685.1 E 6.3 U G M | G |
| | 8 14/2/05 ASH OFF OFF001 Bonsua Junctic Sankyem 6.000 7.000 19685.000 229661 E 6.3 U G H | G |
| 14 T = 1 (E/D/H/M) | 9 14/2/05 ASH 0FF 0FF01 Beeaus Juncta Sankyem 7.000 8.000 22966.000 264471 E 6.3 U G H | G |
| 14. Iopograpny (F/K/H/M) | 10 14/2/03 ASN OFF OFFOOT BEISSING JUNCE SANDYER 8,000 9,000 2004/200 295211 B 6,30 C R 11 14/2/03 ASN OFF OFFOOT BEISSING JUNCE SANDYER 0,000 10,000 2004/2000 390811 B 6,30 C R | 0 |
| | 12 14/2/05 ASN OFF OFFOIL Benaua-Junctic Sankrysm 11.000 12.000 3609.000 393701 E 6.3 U G M | G |
| 15. Roughness G/F/P | 13 14/2/05 ASH OFF OFF001 Bensua Junctic Sankrem 12.000 13.000 59370.000 426511 E 6.3 U G R | G |
| The Hough of the | 14 14/2/05 ASH OFF OFF001 Bensua Junctic Sankyem 13.000 14.000 42651.000 45932 I E 6.3 U G R | G |
| 16 Combon C/E/P | 15 14/2/05 ASH OFF OFF001 Benaua Junctic Bankyem 14.000 15.000 45932.000 49212 I E 6.3 U G M | G |
| 10. Camper G/F/I | 16 14/2/05 ASH OFF OFF001 Bonsua Junctic Sankyem 15.000 16.000 49212.000 52493 I E 6.3 U G M | G |
| | 17 14/2/05 ASH OFF OFF011 Beesus Junctic Sankyem 16.000 17.000 53493.000 537741 E 6.3 U G M | G |
| 17. Drainage G/F/P | 19 14/2/05 ASI 0PF 0PF001 Beneral Junctic Sandreem 12,000 18,000 507/4,000 59051 B 6,00 G 8 | 6 |
| | 20 14/2/05 ASS OFF OFFOIT Benau Juncie Sanderem 19:000 20:000 62336:000 626171 E 6.0 U G M | F |
| 19 Traffa H/M/I | 21 14/2/05 A5H OFF OFF001 Bonaua Junctic Sankyem 20.000 21.000 63617.000 668971 E 6.0 U G R | 9 |
| | 22 14/2/05 ASH OFF OFF001 Bonsua Junctic Sankyem 21.000 22.000 68897.000 72178 t E 6.0 U G R | P |
| | 23 14/2/05 ASH OFF OFF001 Benaus Junctic Sankyem 22.000 23.000 72178.000 75459 I E 6.0 U G R | P |
| 19. Notes | 24 14/2/05 ASH OFF OFFOOI Bonsua Junctic Sankyem 23.000 24.000 75459.000 787401 E 6.0 U G M | G |
| | 25 14/2/05 ASH 0FF 0FF01 Beesua Junctic Sankyem 24.000 24.500 78740.000 803801 E 6.0 U G M | 0 |
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4.1.2 Structures Survey (Attributes) Form

- Columns (Fields)
- Date 1.
- 2. District Code
- Road id
- 4. Start Node Name
- 5. End Node Name
- 6. Structure No
- **River Name**
- **GPS** Northings 8.

| 9. GPS Eastings | 9. | GPS | Eastings |
|-----------------|----|-----|----------|
|-----------------|----|-----|----------|

- 10. Chainage (km+m)
- 11. Structure Type (eg. BC,SB,CP,CB,TB,LB)

- 12. Size (mm) n / dia, n / W x H
- 13. Length (M)
- 14. Headwalls (0/1/2)(R/L)
- 15. Structure Condition Rating (1-5)
- 16. Notes

| Ete Dat | 30em | 2met | Pyrnet Tools | Date 1011 | and 1 | 90 | Adoge PDF | | | | | Type | a question | n for th | - | * × |
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| AB | C | D | E | F | G | H | 1 | 1 | К | E. | M | N | 0 | P | 9 | - |
| 1 Date Re. | Dist | Road | i Start Node | End Node | Stru | Riv | North | East | Latitude | Longitude | Chains | Typ | Sizete | Lec | Rat | NOTES |
| 2 14/02AS | OFF | OFF00 | 1Bonaua Jet | Sankyem | 1 | | 822139.128 | 650004.937 | 6.5606966000 | +1.4122028333 | 0+500 | CB | 2Span, | 8.0 | 1 | 2H PIC |
| 3 14/0CAS | OFF | OFF00 | 1Bonaua Jet | Sankyem | .2 | | 824537.995 | 648100.059 | 6.5630744000 | +1.4140980529 | 1+500 | CP | 1/900 | 8.0 | 1 | 2HW.27 |
| 4 14/0CAS | OFF | OFF00 | 1Bonsua Jet | Sankyem | 3 | | 825913.612 | 644019.812 | 6.5644335200 | +1.4221522000 | 2+900 | CP | 1/900 | 8.0 | 1 | 2HW.29 |
| 5 14/00AS | OFF | OFF00 | 1Bonsus Jct | Sankyem | 4 | | 826084.432 | 643736.389 | 6.5646026162 | -1.4224339243 | 3+020 | CP | 1/600 | 8.2 | 1 | 2HW,2V |
| 6 14/00AS | OFF | OFF00 | /IBonsua Jct | Senkyem | 5 | | 825904.069 | 641836.351 | 6.5644208000 | -1.4243206000 | 3+700 | CP | 1/900 | 8.0 | 1 | 2HW.2V |
| 7 14/01AS | OFF | OFF00: | 1Bonaua Jet | Sankyem | 6 | | 825727.226 | 639992.112 | 6.5642425385 | +1,4301518615 | 4+300 | CP | 1/900 | 8.0 | 1 | 2HW,29 |
| 8 14/05AS | OFF | OFF00: | IBonaua Jet | Sankyem | 7 | | 826001.202 | 639521.065 | 6.5645137143 | -1.4306200743 | 4+400 | CP | 1/900 | 8.0 | 1 | 2HW.27 |
| 9 14/02AS | OFF | OFF00: | 1Bonsus Jct | . Sankyem | 8 | | 826286.463 | 639257.755 | 6.5647964000 | +1.4308820000 | 4+600 | CP | 1/900 | 8.0 | 1 | 2HW,27 |
| 10 14/01AS | OFF | 07700 | 1Bonsus Jet | Sankyem | .9 | | 826425.153 | 639201.175 | 6.5649339454 | -1.4309384000 | 4+650 | CP | 1/600 | 8.3 | 1 | 2HW,27 |
| 11 14/0CAS | OFF | OFF00 | 1Bonsua Jet | Sankyem | 10 | | 827147.755 | 638307.943 | 6.5656496789 | -1.4318265737 | 5+010 | CP | 1/900 | 8.0 | 1 | 2HW,29 |
| 12 14/00AS | OFF | OFFOO: | 1Bonsua Jct | Sankyem | 11 | | 829084.782 | 635934.738 | 6.5715683000 | +1.4341864000 | 6+000 | DC | 1/4x4 | 8.0 | 1 | 2HW,27 |
| 13 14/01AS | OFF | OFF00 | IBonaua Jet | Sankyem | 12 | | 830020.122 | 634975.180 | 6.5724950228 | -1.4351408000 | 6+400 | CP | 1/900 | 8.0 | 1 | 2HW.2V |
| 14 14/02AS | OFF | OFF00 | 1 Bonsua Jet | Sankyem | 13 | | 831753.124 | 633199.713 | 6.5742120500 | -1.4409067500 | 7+200 | CP | 1/900 | 8.2 | 1 | 2HW,27 |
| 15 14/00AS | OFF | OFF00 | 1 Bonsus Jet | Sankyem | 14 | | 832911.996 | 632147.308 | 6.5753604343 | -1.4419537371 | 7+700 | CP | 1/900 | 8.0 | 2 | LHW Br |
| 16 14/00AS | OFF | OFF00 | (Bonstan Jet | Sankyem | 15 | | 834717.364 | 631064.998 | 6.5811503235 | -1.4430314471 | 8+400 | CP | 1/900 | 8.0 | 1 | 2HW.20 |
| 17 14/00AS | OFF | OFFOO: | 1Bonsus Jet | Sankyem | 16 | | 834969.148 | 630944.163 | 6.5813999946 | +1.4431518486 | 8+500 | BC. | 3/4x4 | 8.0 | 1 | 2HW,29 |
| 18 14/0CAS | OFF | OFF00 | 1Bonaua Jet | Sankyem | 17 | | 833417.929 | 630628.589 | 6.5818448537 | -1.4434659659 | 8+700 | CP | 3/900 | 9.0 | - 1 | 2HW.29 |
| 19 14/00AS | OFF | OFF00 | 1Bonsus Jet | Sankyem | 18 | | 836165.699 | 630090.077 | 6.5825860649 | -1.4440019676 | 9+000 | CP. | 1/900 | 8.0 | 1 | 2HW.27 |
| 20 14/00AS | OFF | OFF00 | 1 Bonaua Jet | Sankyem | 19 | | 837599.054 | 628092.907 | 6.5840053167 | -1.4459877500 | 9+800 | CP | 1/900 | 8.0 | 1 | 2HW.29 |
| 21 14/00A5 | OFF | OFF00 | 1Bonsus Jct | Sankyem | 20 | | 538300.184 | 626597.722 | 6.5846987167 | -1.4514738333 | 10+300 | BC | 1/3x2 | 8.2 | 1 | 2HW,29 |
| 22 14/00AS | OFF | OFFO0 | IBonsus Jet | Sankyem | 21 | | 841385.321 | 624830.563 | 6.5917574486 | -1.4532338703 | 11+500 | DC | 2/3x3 | 8.0 | 1 | 2HW.2V |
| 23 14/05AS | OFF | OFF00 | Bonsua Jet | Sankyem | 22 | | 842594.451 | 623561.045 | 6.5929552919 | -1,4544966919 | 12+100 | OCP. | 1/900 | 8.0 | 1 | 2HW,29 |
| 24 14/01AS | OFF | OFFOO. | I Bonaua Jet | Sankyem | 23 | | 843652.503 | 622586.886 | 6.5940036769 | -1.4554659385 | 12+600 | CP | 1/900 | 8.0 | 1 | 2HW.20 |
| 25 14/01AS | OFF | OFF00 | Bonsus Jet | Sankyem | 24 | | 843940.068 | 622229.709 | 6.5942884667 | -1.4558211500 | 12+700 | CP | 1/900 | 8.2 | 1 | 2HW.29 |
| 26 14/00AS | OFF | OFF00: | 1Bonsus Jet | Sankyem | 25 | 1 | 844670.173 | 621498.500 | 6.5950118000 | +1.4605485765 | 13+050 | CF | 1/900 | 8.0 | 1 | 2HW.27 |
| 27 14/0CAS | OFF | OFF00 | 1Bonaua Jet | Sankyem | 26 | | 844095.020 | 619372.276 | 6.5944389000 | +1.4624607667 | 13+100 | BC | 1/2x1 | 8.0 | 1 | 2HW.27 |
| * * * H/Sh | eet1 / | Sheet2 | (Sheet3/ | | | | | | e | | | | | | | 31 |
| Ready | 10000 | A Distance | | | - | | | | | 1.1 | | | 1.1.1 | | | A DECK |
| 1 start | | - Income | | A Mounth. | 11 | | | Arrites CD | Con Henry | | and the | | m 4 .# | 12.4 | 20 | |

Road definition (Attributes)

Columns (Fields)

- Region
- District
- Functional class (I/C/A)
- Road id
- Start node name
- End node name
- Length (km)
- Overall Road condition rating (G/F/P)

4.1.4 Node definition (Attributes)

Columns (Fields)

- Region
- District
- Node id
- Node name
- Node Type (J=Jct, V=Village, R=Ref)
- Northing
- Easting











4.1.5

GIS Map

For the purpose of identifying and classifying, the following functions were used to create GIS Map

- Basic functions (editing, display, measurements,)
- Convert Polyline to PolylineM (adding M-values)
- Overlay
- Dynamic segmentation
- Raster display and analysis
- Surface modeling.
- Links to other software.











5.1 **Two areas were identified**

• 1/ Training and Updating

• 2/ Engineering (Which is a relationship between Hanning and Management review cycles)

1

- - 4 areas are identified
- > Pavement Management System
- ≻ Bridge & culvert Maintenance
- Traffic Engineering

Safety Management



