

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

A case study to the Dept. of Feeder Roads

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1.0 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.

2.0 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
Bituminous Surfaced		4,733
Gravel		6,357
Missing Links		673
Total		13,367
URBAN ROADS		Length (Km)
Asphalt Surfaced		427
Bituminous Surfaced		1,496
Gravel		2,106
Total		4,029
FEEDER ROADS		Length (Km)
Gravel		32,600
Total		32,600
TOTAL LENGTH OF NETWORK		49,996

9. Engineering Class E/P/N
10. Road Width (m)
11. Pavement P/U
12. Surface unpaved R/G/S/C
13. Side Drains L/U
14. Topography (F/R/H/M)
15. Roughness G/F/P
16. Camber G/F/P
17. Drainage G/F/P
18. Traffic H/M/L
19. Notes

1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	DATE:	REG DIST	ROAD NO	START_NODE	END_NODE	START_CHAN	END_CHAN	START_CHAI	END_CHAI	FU EN	ROF PAV	S	U	TOP	ROF	C										
2	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	0.000	1.000	0.000	3281.1	E	6.3	U	G	R	G	F									
3	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	1.000	2.000	3281.000	6562.1	E	6.3	U	G	H	G	F									
4	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	2.000	3.000	4562.000	9842.1	E	6.3	U	G	M	G	F									
5	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	3.000	4.000	9842.000	13123.1	E	6.3	U	G	R	G	F									
6	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	4.000	5.000	13123.000	16404.1	E	6.3	U	G	M	G	F									
7	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	5.000	6.000	16404.000	19685.1	E	6.3	U	G	M	G	F									
8	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	6.000	7.000	19685.000	22966.1	E	6.3	U	G	H	G	F									
9	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	7.000	8.000	22966.000	26247.1	E	6.3	U	G	H	G	F									
10	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	8.000	9.000	26247.000	29527.1	E	6.3	U	G	C	R	G	F								
11	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	9.000	10.000	29527.000	32808.1	E	6.3	U	G	C	R	G	F								
12	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	10.000	11.000	32808.000	36089.000	39370.1	E	6.3	U	G	M	G	F								
13	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	11.000	12.000	36089.000	39370.000	42651.1	E	6.3	U	G	M	G	F								
14	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	12.000	13.000	39370.000	42651.000	45932.1	E	6.3	U	G	R	G	F								
15	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	13.000	14.000	42651.000	45932.000	49212.1	E	6.3	U	G	M	G	F								
16	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	14.000	15.000	45932.000	49212.000	52493.1	E	6.3	U	G	M	G	F								
17	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	15.000	16.000	49212.000	52493.000	55774.1	E	6.3	U	G	M	G	F								
18	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	16.000	17.000	52493.000	55774.000	59055.1	E	6.0	U	G	M	G	F								
19	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	17.000	18.000	55774.000	59055.000	62336.1	E	6.0	U	G	M	G	F								
20	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	18.000	19.000	59055.000	62336.000	65617.1	E	6.0	U	G	M	G	F								
21	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	19.000	20.000	62336.000	65617.000	68897.1	E	6.0	U	G	R	F									
22	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	20.000	21.000	65617.000	68897.000	72178.1	E	6.0	U	G	R	F									
23	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	21.000	22.000	68897.000	72178.000	75459.1	E	6.0	U	G	R	F									
24	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	22.000	23.000	72178.000	75459.000	78740.1	E	6.0	U	G	M	G	F								
25	14/2/05	ASH OFF	OFF001	Bonaua	Juentic	Bankayem	23.000	24.000	75459.000	78740.000	82021.1	E	6.0	U	G	M	G	F								
26	14/2/05	ASH OFF	OFF002	Penodie	Juentic	Penodie	0.000	1.000	0.000	3281.1	A	5.0	U	C	R	F										
27	14/2/05	ASH OFF	OFF002	Penodie	Juentic	Penodie	1.000	1.300	3281.000	4265.1	A	5.0	U	C	R	F										

4.1.2 Structures Survey (Attributes) Form

- Columns (Fields)

 1. Date
 2. District Code
 3. Road id
 4. Start Node Name
 5. End Node Name
 6. Structure No
 7. River Name
 8. GPS Northings

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

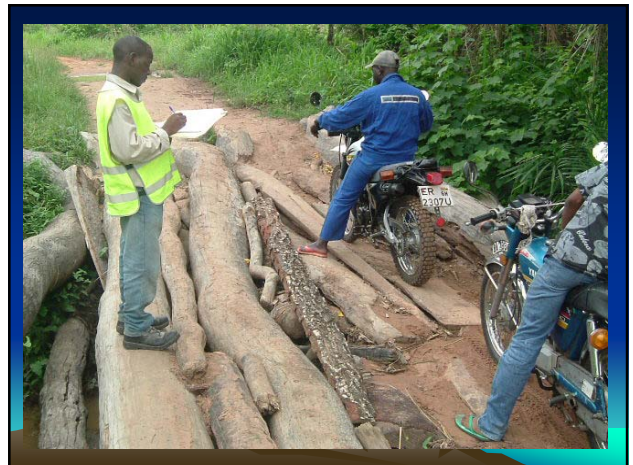
1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	Date	Reg Dist	Road No	Start Node	End Node	River	North	East	Longitude	Chainage	Type	Size	Len	Rof	NOTES											
2	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	822139.129	630004.937	6.566996000	-1.412202833	0-500	CB	200mm	8.0	1.2H	2/F										
3	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	824537.995	648109.059	6.563074400	-1.4140980329	1-500	CP	1/900	8.0	1.2H	2/F										
4	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	823913.612	644019.812	6.564433300	-1.422132200	2-900	CP	1/900	8.0	1.2H	2/F										
5	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	826084.432	643736.389	6.564602612	-1.4224339243	3-020	CP	1/800	8.2	1.2H	2/F										
6	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	827904.069	641836.551	6.564208000	-1.4243236000	3-700	CP	1/900	8.0	1.2H	2/F										
7	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	825727.226	639992.112	6.564242385	-1.4301518615	4-300	CP	1/900	8.0	1.2H	2/F										
8	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	826001.202	639521.065	6.5645137143	-1.4306200743	4-400	CP	1/900	8.0	1.2H	2/F										
9	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	826286.463	639237.755	6.564796400	-1.4308820000	4-600	CP	1/900	8.0	1.2H	2/F										
10	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	831753.124	633199.713	6.5742120500	-1.4409067000	7-200	CP	1/900	8.2	1.2H	2/F										
11	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	832911.996	632147.308	6.5753603433	-1.4419537371	7-700	CP	1/900	8.0	1.2H	2/F										
12	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	834717.564	631064.998	6.5811503235	-1.4430314471	8-400	CP	1/900	8.0	1.2H	2/F										
13	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	834969.148	630944.163	6.5813999946	-1.4431518486	8-500	BC	3/4x4	8.0	1.2H	2/F										
14	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	835417.929	630628.389	6.5818448337	-1.4434609609	8-700	CP	3/900	9.0	1.2H	2/F										
15	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	836165.699	630090.077	6.5823860649	-1.4440029676	9-000	CP	1/900	8.0	1.2H	2/F										
16	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	837599.054	628892.907	6.5840033167	-1.4439877300	9-800	CP	1/900	8.0	1.2H	2/F										
17	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	838300.184	626597.722	6.5846987167	-1.4514738333	10-300	BC	1/3x2	8.2	1.2H	2/F										
18	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	841383.521	624830.563	6.5917574488	-1.4532338703	11-500	BC	2/3x2	8.0	1.2H	2/F										
19	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	845394.451	623361.048	6.5929552919	-1.4544969191	12-100	CP	1/900	8.0	1.2H	2/F										
20	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	843652.503	62286.886	6.5940036769	-1.4534659385	12-600	CP	1/900	8.0	1.2H	2/F										
21	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	843940.068	622229.709	6.5942884667	-1.4538211500	12-700	CP	1/900	8.2	1.2H	2/F										
22	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	844670.173	621499.505	6.5950118000	-1.4602485765	13-050	CP	1/900	8.0	1.2H	2/F										
23	14/02/05	OFF	OFF001	Bonaua	Jet	Bankayem	844996																			

4.1.4 Node definition (Attributes)

Columns (Fields)

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

Practical GPS Exercise



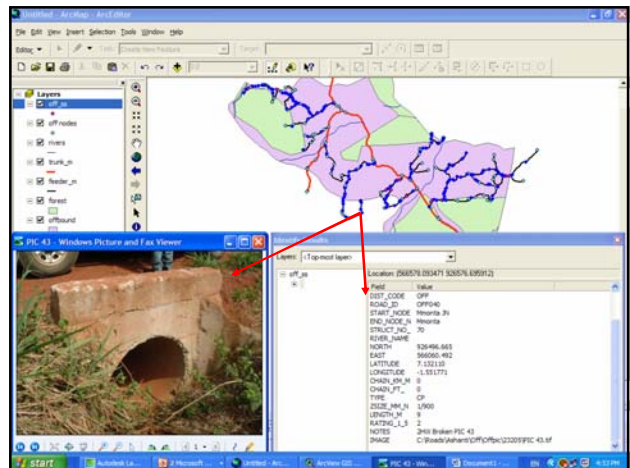
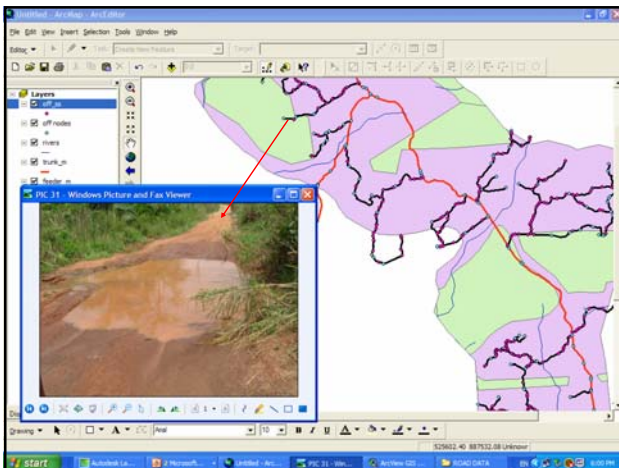
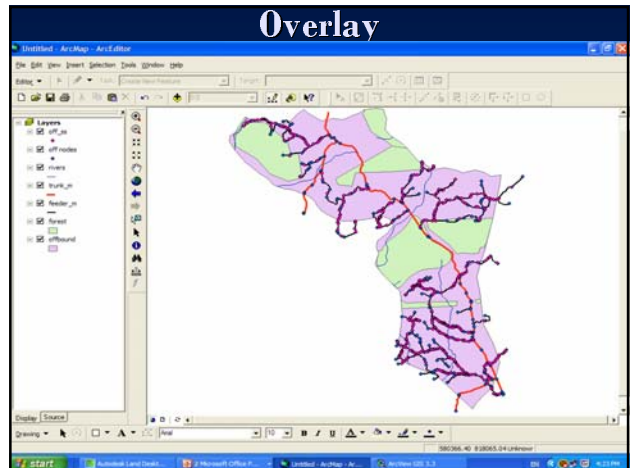
4.1.5

GIS Map

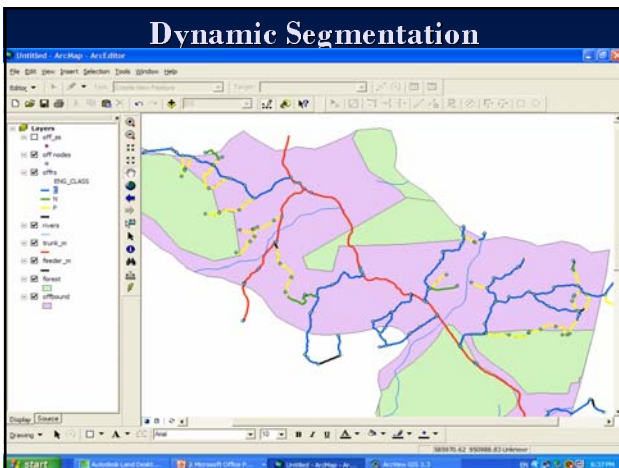
For the purpose of identifying and classifying, the following functions were used to create GIS Map

- 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.

Overlay



Dynamic Segmentation



5.0

The Way Forward

5.1 Two areas were identified

- 1/ **Training and Updating**
- 2/ **Engineering** (Which is a relationship between Planning and Management review cycles)
- - 4 areas are identified
 - **Pavement Management System**
 - **Bridge & culvert Maintenance**
 - **Traffic Engineering**
 - **Safety Management**

6.0

Conclusion

- There is an urgent need to organize the existing database compatible to GIS environment and suggest various other new data items, which are considered useful for better planning and management.
- If GIS technology is exploited to its fullest extent in Ghana it will completely take over the decision making process in transportation engineering. The huge amount of information related to transport infrastructure in Ghana could be put together for its most efficient utilization in planning, design, construction, maintenance and management of the transport system.

Thank You