UML Modeling for General Educational Services in KSA integrated with GIS

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Abstract

This study has approached the distribution and planning of the educational services in Kingdom of Saudi Arabia (KSA) Governorate. This study is of importance since it dealt with one of the most important sections in any community over the economic and social development of the country, as one of the basic necessities of the population. This study aimed at surveying the educational services, to identify to which extent their locations and specifications correspond to the international standards as well as the KSA and to have a clear notion of the distribution of these obstacles that face the implementation of such standards. To achieve this, a study of the concepts relative to planning has been made especially the planning of educational services, as well as the geographical information system that has been used due to its capability in special analysis for the locations of these services. The methodology of the study depended upon the analytical descriptive method in the data analysis framework which was collected from the Ministry of Education in KSA through the field survey of kindergartens and schools. The geographical information system (GIS) was used with the aim of preparing the necessary plans and calculating the data collected as well as the statistical program for the social sciences.

The paper also able to define the workflow for each activity using activity diagrams in UML model. The sequence and activity diagram for the above proposed model is presented. The class diagrams were effective in systematically organizing the information to be used in the education services.

Keywords: UML, GIS, General education Services, Sequence Diagram, Activity Diagram.

1. Introduction

The objectives of the Saudi educational policy are to ensure that education becomes more efficient, to meet the religious, economic and social needs of the country and to eradicate illiteracy among Saudi adults. There are several government agencies involved with planning, administrating and implementing the overall governmental educational policy in Saudi Arabia [2].

The Ministry of Education sets overall standards for the country's educational system (public and private) and also oversees special education for the handicapped. Early in 2003 the General Presidency for Girls' Education was dissolved and its functions taken over by the Ministry, to administer the girls' schools and colleges, supervise kindergartens and nursery schools and sponsor literacy programs for females. See (http://www.sacm.org/Education.aspx).

The education system in Saudi Arabia has five divisions. They are: kindergarten for children from three to six years old, elementary (6-11), intermediate (12-14), secondary level (15-18), and university level (typically 19-24, depending on the subjects studied, and the form of higher education).

1.1 Pre-school education

Kindergartens cater to children aged 3-5 years and are not part of the official education ladder, since attendance is not a prerequisite for enrolment in grade 1 of elementary education. Some private institutions have established nurseries with technical and financial aid from the State [1], [3]. In 1999/2000, there were 962 kindergartens with 93,942 children enrolled. The number of female teachers was 8,789 and the number of administrative staff was 871. According to the UNESCO institute for Statistics (UIS), in 2008 the gross enrolment ratio at the pre-primary level was estimate at 11%. The Ministry of Education reports that in 2009/10 there were 1,521 kindergartens with 106,301 children enrolled. The number of teachers was 10,337 and the number of administrative staff was 2,047 [5].

1.2 Primary education

Children enter elementary education at the age of 6; the duration of studies is six years. Exceptions can be made for children three months under 6 years, especially for those who have followed the pre-elementary stage. All

elementary schools are day schools. Schools are not co-educational. Pupils who pass the examination at the end of grade 6 receive the elementary education certificate, qualifying them for study in the intermediate school [5].

In 1996/97, the average pupil-teacher ratio was 14:1 (schools for boys) and 12:1 (schools for girls), and the average number of pupils per class was 20 (schools for boys) and 21 (schools for girls). In the same school year, the transition rate from grade 6 to the first form of intermediate education was 96.2% for boys and 99% for girls [6].

In 1999/2000, there were 6,148 schools for boys with 1,175,556 pupils enrolled, and 6,086 schools for girls with 1,084,293 pupils enrolled. There were 88,481 male teachers and 100,527 female teachers. 11]. The Ministry of Education reports that in 2009/10 there were 13,602 elementary schools, of which 6,836 for girls and 6,767 for boys. The total enrolment was 2,493,125 pupils, of whom 1,227,699 were girls. The total number of teachers was 223,511 and the number of administrative staff was 11,673. The primary education gross enrolment ratio rose from 82% in 1990 to 99% in 2009, while net enrolment ratio in primary education stood at 95.3% in 2009. The proportion of first graders who reach grade 5 was 97.2% in 2009 [5].

As regards special education, in 2006/07 2,274 boys were enrolled in special education institutions and an additional 40,475 boys were enrolled in special programmes at regular schools. Concerning girls, 3,431 were enrolled in special education institutes and an additional 9,868 girls were enrolled in special programmes at regular schools [1],[6].

1.2 Intermediate education

The elementary stage is followed by the intermediate stage, which lasts three years (grades 7 to 9).
It is possible for those who cannot attend the intermediate school during the day, because of their jobs or their age, to enroll in the evening intermediate school. It is also possible to apply for the final examinations of this stage without having to attend school regularly.
The system of examinations at the intermediate stage is similar to that of the elementary stage. The school year is divided into two semesters and the students' marks are distributed in the same way [6].

In 1996/97, the average student-teacher ratio at the intermediate stage was 13:1 (schools for boys) and 12:1 (schools for girls), and the average number of students per class was 26 (schools for boys) and 28 (schools for girls).
In 1995/96, the transition rate from the third grade

intermediate to the first grade secondary was 88.7% for males and 89.6% for females. In 1999/2000, there were 3,012 intermediate schools for boys with 522,428 students enrolled, and 2,637 intermediate schools for girls with 471,739 students enrolled. There were 42,102 male teachers and 44,588 female teachers. The Ministry of Education reports that in 2009/10 there were 7,910 intermediate education schools, of which 3,780 for girls and 4,130 for boys. The total enrolment was 1,188,342 students, of whom 553,415 were girls. The total number of teachers was 117,370 and the number of administrative staff was 6,289 [5].

1.4 Secondary education

Secondary education is the final stage of general education and lasts three years (grades 10 to 12). Students who successfully complete the intermediate stage receive the intermediate school certificate. All students in the regular secondary schools study a general curriculum during the first year and can choose for the remaining two years one of the following tracks: administration and social sciences; natural sciences; Shariah and Arabic studies. At the end of secondary education successful students receive the secondary school certificate. Technical and vocational education is provided at technical secondary institutes. Training programmes in the fields of industry, commerce and agriculture normally last three years [5].

There are different options at the secondary stage. For girls, there are sciences and arts sections. For boys, there are religious sciences and Arabic; administrative and social sciences; natural sciences; and applied (technological) sciences. There are religion-oriented secondary schools, such as those under Imam Mohammad Bin Saud Islamic University, the Qu'ranic Secondary Schools and Dar Al-Tawheed Secondary School. Some 34 vocational training centers offer two-year training programmes in a variety of fields [6].

There are also secondary schools training women teachers and, in the technical field, there are industrial secondary institutes, commercial secondary institutes, agricultural institutes, technical supervisor institutes and health institutes. Training programmes in the fields of industry, commerce and agriculture last three years. In 1999/2000, there were 35 technical secondary institutes under the General Organization for Technical Education and

Vocational Training. The total enrolment was 19,802 students and the number of teachers was 2,250 [5].

In 1996/97, the average student-teacher ratio at the secondary level was 16:1 (schools for boys) and 12:1 (schools for girls), and the average number of students per class was 29 (boys) and 28 (girls). In 1999/2000, in both the public and private sectors there were 1,441 secondary schools for boys with 328,489 students enrolled, and 1,497 secondary schools for girls with 338,445 students enrolled. There were 22,998 male teachers and 30,688 female teachers. The Ministry of Education reports that in 2009/10 there were 4,909 secondary schools, of which 2,440 for girls and 2,469 for boys. The total enrolment was 1,096,174 students, of whom 490,112 were girls. The total number of teachers was 99,753 and the number of administrative staff was 4,756 [5].

Students who cannot attend during the daytime because of their job may attend evening schools. It is possible to sit for the examinations without having to attend school regularly. This stage is considered the most important period in the general education ladder because students who successfully complete this stage are eligible to join any higher education institution. Technical education includes industrial, commercial and agricultural schools. An Intermediate School Certificate is required for admission. Courses lead to the Secondary Industrial School Diploma, the Secondary Commercial School Diploma and the Secondary Agricultural School Diploma. There are also Technical Assistant Institutes which offer two-year vocational courses in architectural drawing, construction supervision, health supervision, road supervision, surveying and water supervision leading to the Certificate of Technical Assistant Institute. Health Institutes and Nursing Schools offer three- year courses leading to the Health Institute Diploma or the Certificate of Technical Nursing. Male and female education is completely segregated in all levels of school education. See (http://www.sacm.org/Education.aspx).

1.5 Special education

Special education goes in parallel with mainstream education. Educational services are provided to the students who are mentally, visually and hearing handicapped. Special education for boys and for girls is the responsibility of the Ministry of Education. Vocational training and rehabilitation for the disabled are the responsibility of the General Organization of Technical Education and Vocational Training.

The special education programmes in the Kingdom have been developed to cover the physically handicapped by admitting them to the mainstream elementary, intermediate and secondary schools. In 1996/97, the total number of institutes offering special education was 90, with 8,824 students enrolled (of whom 2,658 were girls) assisted by 2,126 teachers (of whom 767 were women). In 1999/2000, there were 118 institutes for boys with 7,597 students enrolled, and 25 institutes for girls with 3,397 students enrolled. There were 1,834 male teachers and 1,018 female teachers [5].

In 2001/02 there were 399 institutes with a total enrolment of 14,482 students; there were 4,317 teachers and 418 assistants and administrative staff [4].

1.6 Private education

Private education in the Kingdom is to be considered one of the elements supporting governmental education at all levels. It includes elementary, intermediate, secondary and adult education. This is in addition to the institutes offering English language programmes. Private education positively contributes to developing human resources and, at the same time, plays an active role by consolidating the economic structure of the country through preparing and training the technical manpower [6].

1.7 Adult and non-formal education

The education system allows the learner to study at any time and at any age he/she wishes. The following options are available:

- Centers for combating of illiteracy: The learner joins these centers regardless of age. The duration of study is three years. The first, second and third years of adult education are equivalent, respectively, to Grades II, IV and VI of elementary education. Educational authorities also organize summer campaigns to combat illiteracy in remote areas which are far from schools.

- Evening schools for males and day schools for females. The students in these schools receive the education which qualifies them to sit the Intermediate Education Certificate and the General Secondary Education Certificate examinations like the students in the formal schools.

There are many other types of education, run either privately or by the government. The Social Service and Continuing Education Centres created in several universities offer a multitude of courses and training programmes in the fields of languages, chemical industries, pharmaceutical services, educational technology, agricultural engineering, first aids and health education [6].

In 1996/97, the total enrolment in adult education programmes amounted to 108,721 learners (of whom 68,710 were women). In 1999/2000, the number of centres for combating illiteracy was 1,155 (males) and 2,112 (females), with 35,168 males learners and 74,876 females learners enrolled. In addition, there were 255 intermediate evening schools (public and private) for males with 41,698 learners enrolled, and 181 secondary evening schools (public and private) for males with 38,172 learners enrolled. In 2001/02, the number of centres for combating illiteracy was 1,152 (males) and 2,435 (females), with 31,100 males learners and 61,553 females learners enrolled [5].

2. GIS and UML Background

Geographic Information System (GIS) is a computer based information system that enables storing, modeling, manipulation, retrieval, analysis and presentation of geographically referred data. GIS are very useful tools for data presentation and visualization. Models are playing very important role to understand real time problem. A model gives an overall idea about the actual problem in a very simple and clear way [7]. The object management group introduced the Unified Modeling Language (UML) for the software designers to develop useful, efficient, effective designs and quality model system for the industry people [8], [9]. The Unified Modeling Language (UML) is a modeling language that

covers a large range of different application domains and which is used to design a scientific and research problems [10]. UML model is an accepting a view of actual real world problem and explaining it in the form of pictures and notations [11]. UML have nine standard diagrams for graphic representation of a system which represent the different points of view of the system. These standard diagrams are: classes, interaction sequence, objects, interaction-communication, and state, use, activities, components and display [12] some of the important domain oriented UML models are designed and shown in [13], [14], [15]. Geography always plays the important role in human's life. A geographic information system (GIS) is a kind of system which is used to capture, designed, store, manipulate, analyze and manage all types of geographically referenced data[16],[17]. The geographic knowledge is applied to human routine tasks such as unfamiliar with the city or searching the exact street or station etc. [18]. Recently there are some important research papers about explaining the GIS system in a very effective and efficient way given in [19], [20]. These are some other papers that are explaining and preventing accidents in a very simple way [21], [22].

3. UML Class Model for General Education Service

A GIS for General Education Services (GES) has been designed with the use of UML concepts and which is shown in Figure 1. UML class diagram demonstrates the structure of the system by depicting classes, attributes and relationship. The complete GIS for (GES) have been designed with attributes and functions. The different properties have been used like association, aggregation, inheritances etc in the form of sub classes and shown in the UML class model. In a UML class diagram Students class has multiple associations with different Categories and Categories has a multiple associations with Students class also. Similarly Students class also has multiple associations with Location class and Education Service class and also has multiple associations with both classes. Categories class has a single association with Education Services class and a signal association with GIS class. GIS class has a single association with Location class and categories class. Finally the Location class has a single association with GIS class and multiple associations with Students class. The diagram in Figure 1 shows that the label * refers to

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multiple associations and the label 1 refers to a signal association.
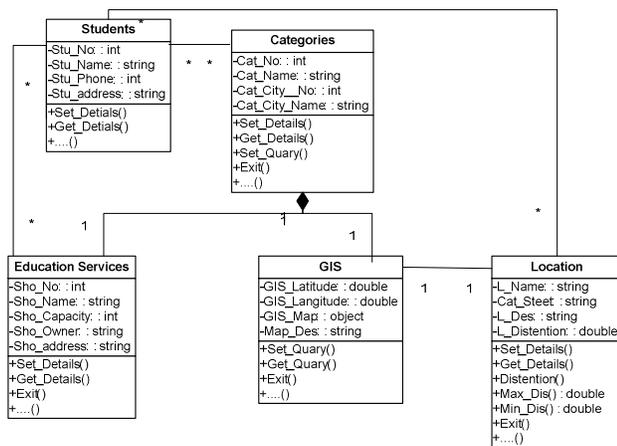
Fig. 1   UML Class Diagram General Education Services

4. UML Activity Diagram for General Education Service

An activity diagram is a kind of flowchart that shows the flow of control step-by-step [23]. The activity diagram shows the various activities one by one with the moving for both controlled and uncontrolled activities. The UML activity diagram of the above model is shown in Figure 2. The activity diagram represents the complete process of Education Services with GIS. According to the activity diagram student needs the information about the suitable education service (school) within the city by looking in the Categories database. When the Categories get the information from student, the system will connect to the GIS system through internet and look for the exact location of the suitable education service. After the student collects the detailed data for the education service (school name, owner, capacity and details deception of the school services), the exact map location will be provided by GIS. Also the student can look finds more details about the location like the destination, maximum and minimum destination, etc.
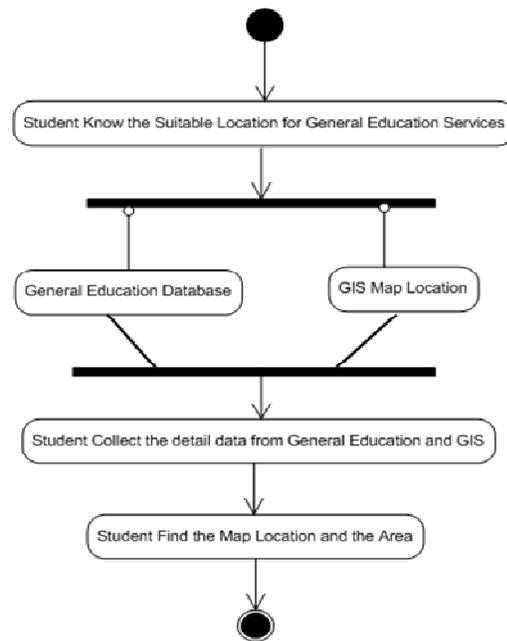
Fig.2.   UML Activity Diagram for General Education Service

5. UML Sequence Diagram for General Education Service

The sequence diagram is representing the interactions between objects. It passes the message from top to bottom. The sequence diagram of above GES with UML model is given in Figure 3. This sequence diagram of GES has five important objects which are shown on the top of the diagram in the form of rectangle boxes with their class names. The five main objects are Students, Categories, Education Services, GIS and Location. The communication between two objects is shows by an arrow and the message of that arrow. According to the sequence diagram given in Figure 3, Students send a query to the Categories to collect the best suitable education service (school). As response, the Categories give the requested data to back. When the student knows the needed service he requests the map location using the GIS via internet. The GIS system finds the exact location of the best suitable school after which the system searches the area map related for the student request and returns the location map for the best school back to the student.
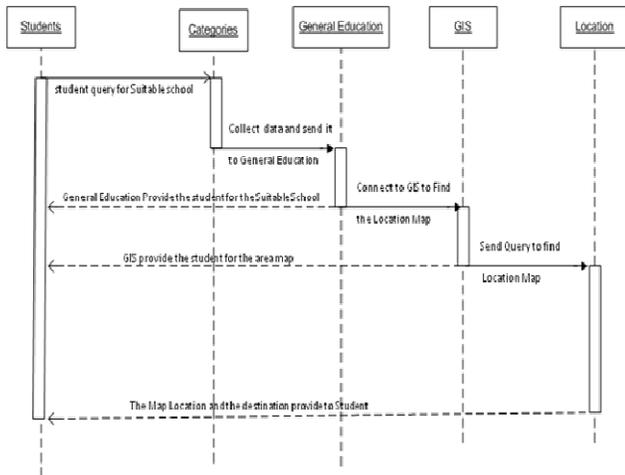
Fig. 3   UML Sequence Diagram for General Education Service

6. Experimental Study

Table 1 illustrates how much importance is given to education services in Saudi Arabia. We can see the big number of schools and students. Examples in 2009/10 there were 1,521 kindergartens with 106,301 children enrolled. The number of teachers was 10,337 and the number of Teachers was 10,337.but in 2011/12 there was 2,323 kindergartens with 141,422 children enrolled. In 2009/10 there were 13,628 elementary schools, of which the total enrolment was 2,493,125 pupils, of whom 1,227,699 were girls. The total number of teachers was 223,511. The primary education gross enrolment ratio rose from 82% in 1990 to 99% in 2009, while net enrolment ratio in primary education stood at 95.3% in 2009. The proportion of first graders who reach grade 5 was 97.2% in 2009 [5]. In 2009/10 there were 7,910 intermediate education schools, of which the total enrolment was 1,188,342 students, of whom 553,415 were girls. The total number of teachers was 117,370. In 2009/10 there were 4,909 secondary schools, of which the total enrolment was 1,096,174 students, of whom 490,112 were girls. The total number of teachers was 99,753 [5].

The figure 4 illustrated the number of schools in the general education in Saudi Arabia for years 2009/10 until 2011/12. That is clear the number of schools is proximity same in year 2009/10 and 2011/2012 for elementary and secondary schools. The number of schools in special education is decreases in 2011/2012 comparing with 2009/2010. Basically it was normal to increase the number of schools year after year, commensurate with the increasing number of students.

Table 1: Summary Statistics on General Education in K.S.A Academic Year 2009 to 2012

Stages	Schools	Students	Teachers	Schools	Students	Teachers	Schools	Students	Teachers
Kindergarten	1521	106301	10337	1676	117653	11431	2323	141422	12705
Elementary	13802	2493125	223511	13628	2513815	228325	13845	2530744	232453
Intermediate	7910	1188342	117370	7999	1198414	122480	8241	1212029	125355
Secondary	4909	1096174	99753	5013	1125602	102416	5158	1226205	114625
Adult Ed.	1551	82771	13319	3085	82797	10197	2979	49659	7899
Special Ed.	3924	26325	7802	1594	27138	7859	1703	27439	8074
	2009/10			**2010/11**			**2011/2012**		
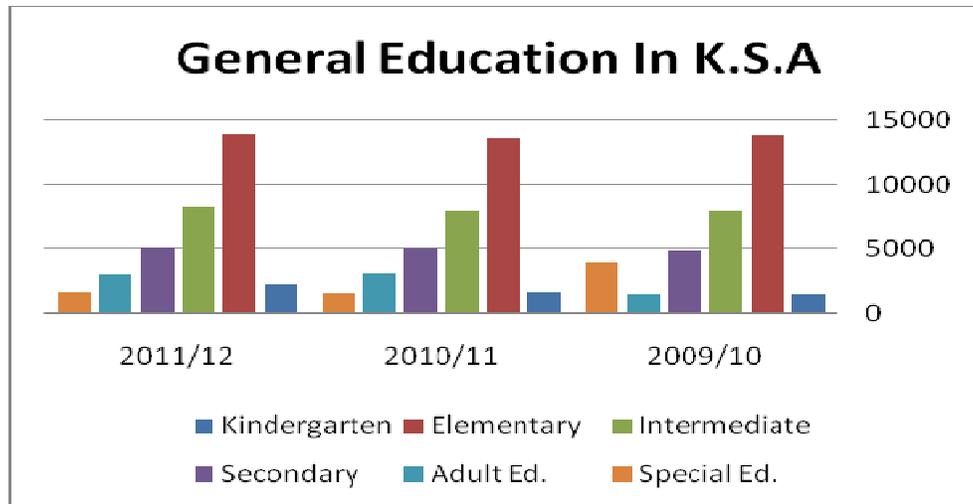
Fig. 4 Statistics on General Education in K.S.A Academic for the Schools

7. Conclusion

This paper has focused on providing an overview of the education system in Saudi Arabia, and the aims of to present the process of education with ULM modeling integrated with GIS which are the target of this study. This paper show that is very important to increases the number of schools for all stages to suitable with the increasing of student, year by year. The study recommended the necessity of studying the trends of constructional growth and the population growth rates to choose the best sites possible for the schools and to follow the planning principles and measures. It also recommended the necessity to rehabilitate the schools to achieve the new methods of teaching and the curriculum requirements. The study also recommended that should be having unit or center in Ministry of Education call it GIS unit to help and provide the student data and GIS Map.

References

[1]   Arab Bureau of Education for the Gulf States (ABEGS). The experience of the Kingdom of Saudi Arabia in mainstreaming students with special educational needs in public schools. (A success story). Riyadh, 2010.

[2]   Ministry of Economy and Planning. UN Team. UNDP. Kingdom of Saudi Arabia Millennium Development Goals Report 2010. Riyadh, 2010.

[3]   Ministry of Education. General Administration for Eradication of Illiteracy Programmes. The achieved progress in the field of the eradication of illiteracy in the Kingdom of Saudi Arabia from 1997 to 2009. Riyadh, 2008.

[4]   Ministry of Education. Ministry of Higher Education. General Organization for Technical Education and Vocational Training. The Development of education.

Presented at the 47th session of the International Conference on Education, Geneva, 2004.

[5]   The Ministry of Education reports," Summary Statistics on General Education in K.S.A", reports for year 2009/10, 2010/12 and 2011/12. At website address http://www.moe.gov.sa/pages/stats_summary.aspx

[6]   World Data on Education. 7th edition, 2010/11, UNESCO-IBE/2011/CP/WDE/SU, http://unesdoc.unesco.org/images/0021/002116/211628e.pdf

[7]   G. Booch, J. Rumbaugh, and I, Jacobson "The Unified Modelling Language User   guide", Addison-Wesley, Reading, MA, 1999.

[8]   OMG Unified Modeling Language Specification, Available online via http://www.omg.org, 2001.

[9]   Kovacevic, S. UML and User Interface Design, inUML'98. Mulhouse – France, year, 1998.

[10]   Roff, T., UML: A Beginner's Guide, Tata McGraw-Hill Edition, Fifth Reprint, 2006.

[11] Craig Larman: "Applying UML and Pattern", Prentice Hall, 1998.

[12]   Booch, G., Rumbaugh, J. & Jacobson, I. The UML reference manual (2nd ed.). Boston: Addison-Wesley, 2004.

[13] V. Saxena and Ansari, G.A., Ajay Pratap "Enhancing Security through UML", "International Journal of Computer Sciences, Software Engineering and Electrical Communication Engineering" Vol. 2(1), pp 31-36 June 2011.

[14] Ansari, G.A., "A Domain Oriented Modeling of Indian Education System through UML" the Icfai Journal of Systems Management (IJSM) (ICFAI Press India), Vol. VIII; No.3; August, 2010.

[15] V. Saxena and Ansari, G.A., "UML Modeling & Protection of Domain Based System" International Journal of Computer Science and Network Security (IJCSNS), South Korea, Vol. 8, No. 7, pp. 338-344, July 2008.

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www.IJCSI.org

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[16] Geographic Information Systems as an Integrating Technology: Context, Concepts, and Definitions" ESRI, 9 June 2011.

[17] Amdahl, G. Disaster Response: GIS for Public Safety, ESRI Press: Redlands, California, 2001.

[18] De Smith, M.G., Goodchild, M.F. & Longley, P.A., Geospatial Analysis: A Comprehensive Guide to Priciples, Techniques, and Software Tools.Winchelsea Press: Leicester, 2007.

[19] Fonseca, Frederico, Sheth, Amit "The Geospatial Semantic Web" UCGIS, White Paper, 2002.

[20] Longley, P.A, Goodchild, M.F, Maguire, D.J and Rhind, D.W "Geographic Information Systems and Sciences, Chichester: Wiley, 2nd edition, 2005.

[21] A.S. Al-Ghamdi, Z. Nemeth and R.Rogness. "Forecasting Traffic Accidents in Saudi Arabia by Using a Time Series Model" Presented at the 72nd Annual Meeting of TRB Conference, Washington, D.C, 1993.

[22] S.E. Asogwa, The Use of the Police for Limited Road Accident Data Collected in Developing Countries. Accident Analysis and Prevention, Vol. 14, No.3, pp. 203-208 1982.

[23] Ericcson. Maria. "Activity Diagrams: What They Are and How to Use Them" http://www.ibm.com/developerworks/rational/library/2802.html Accessed on dated 1-1-2012.

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