

# Coordinates

Volume XIX, Issue 6, June 2023

THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

## SURVEYING IN NIGERIA

### Academic and professional challenges

How prepared is Delhi for a 7 intensity earthquake?

# In Coordinates



mycoordinates.org/vol-9-issue-6-June-2013

## 10 years before...

### Tracking the prey rather than the predator with GNSS

**Dr Volker Janssen**

Honorary Research Associate, School of Geography and Environmental Studies, University of Tasmania, Hobart, Australia

This paper has presented an indirect approach for tracking drop bears using GNSS technology. Tracking the prey rather than the predator has proven to be effective in determining the number and spatial distribution of drop bears present in the study area. It has also revealed the animal's particular nutritional targeting preferences. This bush-path breaking study has begun to provide a much better understanding of the ecology of the drop bear. Bushwalkers should be vigilant when hiking along less frequented paths in Australia and take precautions in areas known to be inhabited by drop bears. In these areas, conservation practices can now be enhanced.

### Geodynamical study of the territory of Balkan peninsula

**Keranka Vassileva**

National Institute of Geophysics, Geodesy and Geography, Bulgarian Academy of Sciences, Bulgarian

Geodynamic investigations have been accomplished on the base of GPS data of all free available GNSS permanent stations on the territory of the Balkan Peninsula within the time of four and five years in winter, spring summer and autumn seasons.

### A hybrid GIS space syntax methodology for prioritizing slums

**Ayman M Ismail**

Professor of Planning  
Fayoum University, Egypt

**Hussam Bakr**

Professor of Architecture,  
Helwan University, Egypt

**Salma Anas**

Masters Candidate  
Fayoum University, Egypt

This study has shown that prioritizing intervention on the local level should be clearly supported by a declared political vision as well as a scientific methodology that takes in to account different factors and indices.

### Integrating surveying methodologies to provide specific solutions

**Donatella Dominici, Elisa Rosciano and Michail Elaiopoulos**

Department of Civil, Environmental Engineering and Architecture, University of L'Aquila, Italy

The presented research illustrates a synergy among different techniques and instruments. The motivation of the paper is to highlight that there is no need of searching particular methods neither advanced technologies to overcome with apparently complex situations. The integration and the smart use of well-established techniques can meet the requirements of any situation, especially in problematic cases such as post-calamity emergencies.

### Improving land administration systems in developing countries

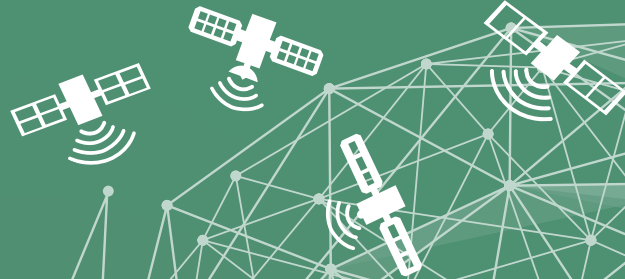
**Jouni Johannes Anttonen**

M.Sc. (Surv.) FM-International Oy FINNMAP  
Team Leader, Land Administration  
Sub Sector Programme (LASSP), Ministry of Land  
Management, Urban Planning and Construction  
(MLMUPC), Phnom Penh, Cambodia

It is also clear that strong local ownership and commitment with proper coordination, cooperation and real team work with all land sector stakeholders and various Development Partners involved (In Cambodia, Technical Working Group on Land (TWG-L) coordinates donor efforts in the land sector.) is essential to maximize benefits, avoid overlapping and minimize the waste of effort, time, money and general confusion in the land sector.



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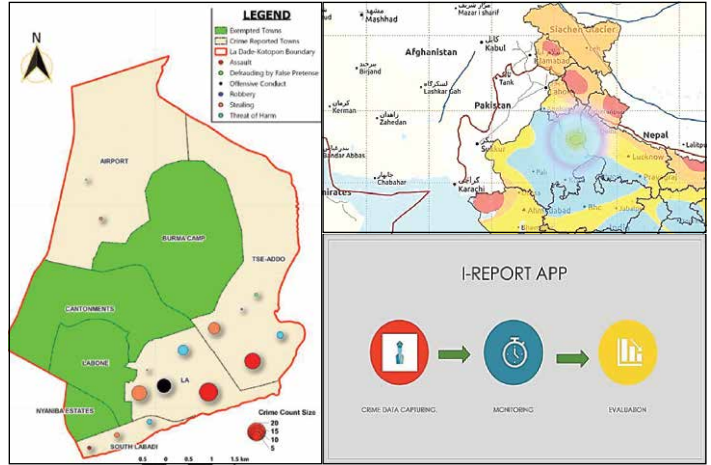
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This issue has been made possible by the support and good wishes of the following individuals and companies

A A Acheampong, A K Jain, Amarachi Oteyi, C Y Asante, D Duffour, Emilia Biobele West, Godwill Tamunobiekiri Pepple, and Precious Lenyie; SBG System, and many others.

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Coordinates is an initiative of CMPL that aims to broaden the scope of positioning, navigation and related technologies.

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**Annual subscription** (12 issues)

[India] Rs.1,800\* [Overseas] US\$100\*

\*Excluding postage and handling charges

**Printed and published** by Sanjay Malaviya on behalf of Coordinates Media Pvt Ltd

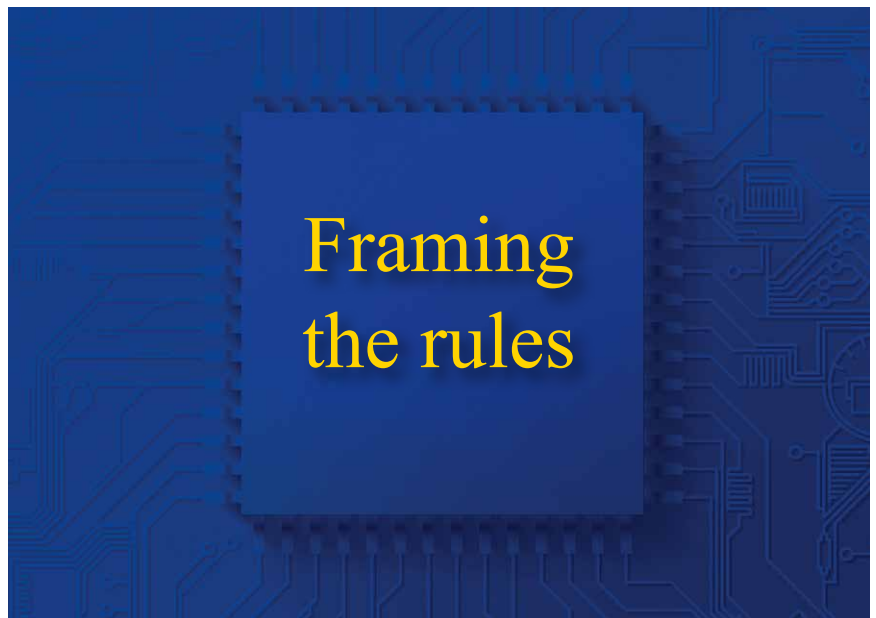
**Published** at A 002 Mansara Apartments, Vasundhara Enclave, Delhi 110096, India.

**Printed** at Thomson Press (India) Ltd, Mathura Road, Faridabad, India

**Editor** Bal Krishna

**Owner** Coordinates Media Pvt Ltd (CMPL)

This issue of Coordinates is of 36 pages, including cover.



The European Union takes the lead

In bringing out 'The AI Act' - the first ever law  
anywhere to regulate Artificial Intelligence.

The proposed Act prohibits the use of the AI,

Where the risks of using it is unacceptable

such as real-time facial identification system etc.

As the policy makers all across the globe

race to control the AI technology

that is evolving at alarming rate,

It may not be easy to tame the ecosystem

That facilitates and gains from this technology.

It is too powerful!

Bal Krishna, Editor  
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# "Surveying in Nigeria: Academic and professional challenges"

This article has identified and grouped 6 challenges the Surveying profession is grappling with in order to ensure its future and survival



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## Brief history of surveying in Nigeria

The initiative of Surveying in Nigeria can be said to be as old as the country itself. Surveying as the name implies is the oldest tertiary professional course of study and one of the oldest organized professions practiced in the country (NIS, 2013). The Surveying profession plays a key role in physical, economic and developmental planning in Nigeria as the bedrock of every meaningful development (NIS, 2013). Training in surveying commenced locally in 1908 as a survey school which was the first post secondary school established in Lagos, Nigeria to meet the exigency of Surveying and mapping of the country (NIS, 2013; Kabir et al., 2022). Ayeni (1982) noted that the survey practice existed even before the amalgamation of the Northern and Southern protectorates in 1914. As at 1899 and 1900 survey departments existed in Lagos and Kaduna respectively whose major activities were mostly cadastral (Ayeni, 1982). The discovery of Coal at Udi in 1904 and Tin at Barkin Ladi in 1912 led to the establishment of two coal cities in Enugu and Port Harcourt and the Tin city of Jos, while the boom in agricultural activities in Kano provided the necessary rationale for carrying out cadastral surveys (Okoronkwo, 1984).

The survey practice deals with geospatial or locational data which may be obtained from different sources including Earth orbital satellites, aircrafts and ground-based instruments. Furthermore, Ebong (1981) stated that the first system of survey level established in Nigeria was in 1891, while the first system of levelling for vertical controls in Nigeria started in 1920 and continued up to 1945 (Fajemirokun & Nwilo, 1990; Fajemirokun & Nwilo, 2000). Before regions were created in the early fifties, surveying in the country was under one umbrella known as Federal Surveys with sub-headquarters in Ibadan, Enugu, Kaduna and the headquarters in Lagos. The Nigeria Institution of Surveyors (NIS) is one of the oldest organized professional Bodies in Nigeria which started in 1934 as the "Licensed Surveyors Association" under the able leadership of the late Nationalist, Herbert Macaulay, in 1960, the name was changed to the "Land Surveyors Association of Nigeria" with the late Surv. C. T. Olumide as National Chairman. The current name "The Nigerian Institution of Surveyors" was adopted at the Enugu Conference in 1966 with the late Surv. C. T. Olumide elected as its first President.

Surveying education in Nigeria is now offered at three levels, namely technical, technological and professional. The technicians are trained in the polytechnics,

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The image of a profession is important because it influences public perception, affects career growth, and earning potential. Several factors contribute to the poor professional image of surveyors

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the technologists are trained also in the polytechnics and colleges of technologies while the professional training is carried out mainly in the universities (Balogun, et al., 2013; Kabir et al., 2022). Surveying in Nigeria had always been governed by laws and regulations since the introduction of the profession into the country. This is to ensure high standard of the professional practice and to protect the interest of the public to whom surveyors render his/her services. Over 80% of Nigerian schools do not introduce the Elementary Surveying as a profession to students. Thus, many post primary school leavers lack the basic information of Institutions offering Surveying and Geoinformatics programmes in Nigeria, its entry requirement, how to go about becoming a professional Surveyor and opportunities accruable to a graduate Surveyor (Kabir et al., 2022).

This had led to wrong perception and unnecessary doubts for the profession, since Africa is one of the continents obviously lagging behind in educational and professional attainment (Hannah, et al., 2009). Nigeria the most populous country in Africa with a population of over 200 million people, having witnessed a steady decline in the quantity and quality of surveying professionals over the years. As at now the Nigerian professional surveyors are less than 6000 (dead and alive). Since surveying is a highly specialized field, and it requires a great deal of knowledge and skill. As such, it is important to understand the academic and professional challenges that come with surveying in Nigeria. This article has identified and grouped 6 challenges the Surveying profession is grappled with in order to ensure its future and survival.

## Poor professional image

The perception of a profession by the public, its reputation, trustworthiness, and level of expertise begets a good professional image. The image of a profession is important because it influences public perception, affects career growth, and earning potential.

Several factors contribute to the poor professional image of surveyors which includes the following:

- a. **Poor public awareness:** The poor public awareness of the roles of surveying and inability to understand the different aspects of the profession, such as Cadastral, Engineering, Hydrographic, Mining, Topographic, Photogrammetric and Remotely sensed Surveying. There is no post primary training that will necessitate a foundation for people who intend to study Surveying and Geomatics at tertiary level.
- b. **Outdated and incomplete laws:** Survey laws in Nigeria are drawn from the existing colonial Western, Eastern and Northern regions which has necessitated varying survey laws from state to state. CAP 194 which has four parts (Survey Ordinance, Survey Regulations, Survey fee and qualifications of Surveyors and Survey Regulations (Lagos) that was repealed in 1989 but not completely replaced by CAP 425 which has five sections (Surveyors Council of Nigeria, The registrar, Registration, Professional discipline and Miscellaneous and General) and two schedules (supplementary provisions relating to the Council and supplementary provisions relating to the disciplinary committee and investigating panel).
- c. **Corruption:** Many surveyors engage in sharp practices, such as falsification of survey reports or manipulation of data or records. This unethical behavior undermines the integrity of the profession and makes it difficult for honest surveyors to build a positive professional image.
- d. **Lack of modern equipment and technology:** Without access to the latest tools and techniques, surveyors may struggle to provide accurate and reliable data which can further damage their reputation and make it difficult to compete with other professionals who have access to modern equipment and technology.
- e. **Lack of recognition and support:** Surveyors are often undervalued, and their contributions are not recognized,

leading to a lack of motivation and dedication to the profession which can further make it difficult for surveyors to build a positive professional image.

- f. **Poor perception and marketing:** Poor public perception or marketing of the surveying profession is one of the factors confronting a surveyor. Every Surveyor shall be governed by the provision of the Surveyor Council of Nigeria (SURCON). The code of ethics in the survey profession as prescribed by SURCON Decree 1989 No. 44 Section 7. The professional Surveyor is not allowed to advertise or offers his services by means of circulars or paid announcements in any sound, motion and print medium.

## Lack of interest in surveying

The lack of interest in surveying by prospecting students has led to a shortage of qualified surveyors in the country. The surveying profession is essential to land use planning and infrastructural development. Here are some reasons for this lack of interest include:

- a. **Perception of surveying as a low-status profession:** There is a perception that surveying is a low-status profession compared to other professions such as medicine or law. This has made most young people view other professions as more prestigious and financially rewarding.
- b. **Lack of awareness about surveying:** Most people are not aware of surveyor's role in land use planning, infrastructure development and management which is the foundation for any meaningful development.
- c. **Difficulty of the profession:** Surveying is a technical profession that requires specialized skills and knowledge. Many young people may view surveying as a difficult profession, which can deter them from pursuing it as a career.
- d. **Inadequate remuneration:** The compensation for surveyors is often perceived as inadequate compared to other professions. This has made most young people seek for more financially rewarding careers.

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Professional boundaries are defined by the ethical and regulatory guidelines of a profession and are essential to maintain professional standards and protect the public interest. Surveyors face several challenges related to the collapse of professional boundaries

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### Poor training and retraining

Currently, only twenty (20) Universities and thirty-six (36) Monotechnics/ Polytechnics/ Colleges of Technology in Nigeria offering Surveying and Geoinformatics at different levels are recognized (SURCON, 2019; Kabir et al., 2022), and these institutions often lack the resource of providing quality training. As a result of this challenge, many surveyors are not adequately prepared for the task ahead because they need to be conversant in a variety of subjects, including mathematics, physics and geography, as the profession requires a high level of technical expertise and specialized skills to adequately perform their jobs. These poor training are due to the following reasons:

#### a. **Inadequate educational**

**infrastructure:** The educational infrastructure is often inadequate in some institutions such as accommodation, electricity, water supply, laboratory, library and rest rooms. Many schools lack these resources and facilities needed to provide quality training in surveying.

b. **Insufficient funding:** The surveying profession requires significant investment in equipment and technology. There is often a lack of funding for surveying programs, leading to a lack of access to the equipment and technology needed for effective training.

c. **Unification of training:** The quality of training can vary significantly between institutions, leading to differences in the skills and knowledge of surveyors.

d. **Outdated curriculum:** The curriculum used in many surveying

institutions are often obsolete and does not reflect current industry standards and best practices. This can lead to a gap between the skills and knowledge taught in the classroom and the skills and knowledge needed in the field.

e. **Limited opportunities for professional development:** Surveyors often have limited opportunities for professional development, such as attending conferences, seminars, and workshops which can make it difficult for surveyors to stay up-to-date with the latest industry trends and best practices.

### Collapse of professional boundaries

Professional boundaries are defined by the ethical and regulatory guidelines of a profession and are essential to maintain professional standards and protect the public interest. Surveyors face several challenges related to the collapse of professional boundaries that includes the following:

a. **Conflict of interest:** Surveyors may face conflicts of interest when they are asked to provide services to clients who have competing interests. A surveyor may be asked to provide a survey report for a property owned by a family member or friend which in most cases, the surveyor may face pressure to provide a favorable report, even if the report is not accurate or in the best interest of the public.

b. **Lack of impartiality:** Surveyors are expected to be impartial and provide objective data and analysis. Surveyors

may be influenced by personal biases, financial interests, or pressure from clients to provide biased reports.

c. **Over-stepping professional boundaries:** Surveyors may face pressure to provide services that are outside their area of expertise or competence. A surveyor may be asked to provide legal advice or construction supervision, which may not be within the scope of their profession.

d. **Opposition from civil engineers:** Surveyors were regulated earlier than civil engineers, yet the licensed engineers seem to have a comparative advantage which has absorbed the practice of surveying into civil engineering in most countries for years. The detachment of surveying from civil engineering is still not complete but recognition of the skill and knowledge of Surveying as a separate profession has become evident.

e. **Ethical dilemmas:** Surveyors may face ethical dilemmas when they are asked to provide services that conflict with their ethical standards. A surveyor may be asked to provide a survey report for a property that was obtained through illegal means. In such cases, the surveyor may choose to uphold ethical standards or meet the demands of their clients.

f. **Duplication of beacon numbers:** As at today, some Surveyors use survey beacon numbers allocated to them previously for another location or forge numbers assigned to another surveyor for a new survey in order to avoid mandatory payment for formal processing of new surveys.

g. **Back dating of survey records and plans:** On the other hand, back dating of survey records to meet with the demand of some clients in cases where the surveyed land is in dispute.

h. **Deceased Surveyors in active practice:** As at today, non-Surveyors practice actively with the seal and details of a deceased Surveyor which has resulted to a huge number of fake plans/maps in circulation that can further erode public trust of the profession.



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Another cause for great concern is the rate at which newly-registered surveyors open up their own firms and break away without consideration of the fact that professional survey practice requires great team work, while equipment outlay is highly capital intensive

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### Lack of team work

Another cause for great concern is the rate at which newly-registered surveyors open up their own firms and break away without consideration of the fact that professional survey practice requires great team work, while equipment outlay is highly capital intensive. The unhealthy competition and rivalry, leaving most practicing surveyors with the option of cutting corners or indulging in unethical practices in order to survive. Surveying involves a range of tasks that require collaboration between professionals within the built environment. Some causes of lack of teamwork, includes the following:

- a. **Lack of communication:** Communication is essential for effective teamwork. There is often a lack of communication between surveyors and other professionals which can lead to misunderstandings and errors in the planning and execution of projects.
- b. **Lack of trust:** Trust is vital for effective teamwork which in most cases can lead to conflicts and delays in the planning and execution of projects.
- c. **Lack of collaboration:** Collaboration is necessary for effective teamwork which in most cases can lead to duplication of efforts and inefficiencies in the planning and execution of projects.
- d. **Resistance to change:** Resistance to change can be a significant barrier to effective teamwork which can lead to a lack of innovation and creativity in the planning and execution of projects.

### Lack of resources

The surveying profession involves the use of a wide range of resources, which include equipment, technology and human resources that are often expensive and are mostly imported. Some of the key factors that contribute to the lack of resources include:

- a. **Inadequate funding:** The surveying profession is often underfunded, that leads to a lack of resources which affects the quality of training, research, and provision of surveying services.
- b. **Limited access to modern equipment:** The lack of access to modern surveying equipment and technology is also a significant challenge because most surveyors still rely on outdated and manual surveying techniques, which can be time-consuming and inaccurate.
- c. **Insufficient training and development opportunities:** The lack of training and development opportunities for surveyors affects the quality of surveying services provided and can result in a shortage of skilled surveyors.
- d. **Inadequate staffing:** Many surveying firms are understaffed, which affects their ability to provide timely and accurate surveying services.

### Conclusion

In line with the findings of Ruther (2003), which suggested that the solutions to the multifaceted difficulties and problems highlighted above are evasive and requires significant planning, commitment and change of attitude from the surveying community. Steps towards a possible improvement could

be: Educational Database, Curricula Reviews, Joint Postgraduate Programs and Short Courses, General Networking between Educational Institutions and Joint Research Projects, Collaboration with other Institutions and Organisations and Donor Support. Nwilo and Osanwuta (2004) also identified that Surveying is a highly technical profession, and it is often overlooked by the government and other organizations. By training, education, and ethical guidance, surveyors can maintain their professional boundaries and uphold their responsibilities required for developing regulations and guidelines to promote professionalism and ethical conduct.

As such significant investment in educational infrastructure, funding for surveying programs, and the development of standardized training programs that reflect current industry standards and international best practices should be encouraged. While improving communication, building trust, encouraging collaboration, and fostering a culture of innovation between surveyors and other professionals can ensure the successful planning and execution of infrastructural projects. Lastly, increased funding, improved access to modern equipment and technology, more training and development opportunities, and better staffing of survey offices can become more efficient, effective, and responsive to the needs of society because surveying plays a crucial role in shaping the world around us.

### Recommendations

- 1 Surveying curricula should be frequently reviewed in line with modern instrumentation and information technology.
- 2 NIS the professional body and SURCON the regulatory body should work closely with professionals in higher institutions, public service and in private practice to modernize professional practice in Nigeria and promote the well-

As such significant investment in educational infrastructure, funding for surveying programs, and the development of standardized training programs that reflect current industry standards and international best practices should be encouraged

being of the profession by extracting and documenting the survey content required in all sectors of the economy.

3 A pupillage school of surveying should be established to cater for the registration of surveyors with first degree certificate or its equivalent in Surveying and Geomatics. The training for our intending surveyors must be intensified by adequately staffed and equipped programmes in tertiary institutions.

4 SURCON should updated its register yearly and publish names of deceased Surveyors and their seals retrived to avoid it being used by non-surveyors for active private practice after the demise of said surveyors.

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# How prepared is Delhi for a 7 intensity earthquake?

The apprehension that whether Delhi would withstand an earthquake of 7 magnitude similar to that occurred in Turkey this year needs to be pondered upon seriously



## A K Jain

worked as Commissioner (Planning), Delhi Development Authority and as a member of the Committee of the Ministry of Housing and Urban Affairs on the DDA (2015). He was a member of UN Habitat (2007-12). Author of several books, he is visiting faculty in planning and architecture. He was awarded 2nd Urban Professional Award 2014 at World Urban Forum in Medellin, Colombia, IBC Lifetime Achievement Award (2023), Living Legend Award by the Indian Institute of Architects (2022) and the Lifetime Achievement Award by the Smart Habitat Foundation (2022).

The devastating and deadly earthquake of 7.8 on the Richter Scale hit Southern Turkey and Syria on 6<sup>th</sup> February 2023 sent shivers in Delhi. It left 50,399 dead and 1,07,000 injured. Approximately 2.4 million people were shifted in temporary shelters, including 5,25,000 tents and 36,000 containers. Earlier, the Gujarat earthquake, also known as Bhuj earthquake on 26<sup>th</sup> January 2001, with an intensity of 6.9, left over 20,000 dead and more than 1,65,000 people injured (Fig. 1).

The Tejendra Khanna Committee in its report (2006) sent a warning stating that 70 to 80% of the structures in Delhi were violative of building and development control regulations. The unsafe buildings are mostly more than 50 years old, non-engineered, and dilapidated, like those in the Old City, villages and unauthorised colonies. The Ministry of Urban Development and Poverty Alleviation issued a Gazette notification dated 21.3.2001, for safety of buildings to withstand the earthquake and incorporating such

provisions in the Building Byelaws and Master Plan for Delhi 2021 (Fig. 2).

The Building Materials and Technology Promotion Council (BMTPC) prepared a vulnerability atlas indicating seismic zone map of India (Figs. 3, 4 and 5) and guidelines for earthquake and disaster prevention, preparedness, and mitigation. As per this Atlas, Delhi falls under Seismic Zone IV. Figs 6 and 7 show the Seismic Hazard Micro Zonation map of NCT Delhi which categorises the areas under low, moderate and high risks.

In 2005, the Parliament enacted the National Disaster Management Act under which the National Disaster Management Authority (NDMA), NDRF, and National Institute of Disaster Management (NIDM) were established. The National Disaster Response Force (NDRF) has been commended for many successful rescue and relief operations in India, as well as in Turkey and Syria earthquake recently.



Fig. 1: The Gujarat earthquake on 26 January 2001 left over 20,000 people dead and more than 1,65,000 injured.

**MINISTRY OF URBAN DEVELOPMENT & POVERTY ALLEVIATION**

**Notification No. K-12016/5/79-DDA/A/VA/IB (Pt.) dt. 21st March, 2001 regarding, Safety Feature to provide in building in respect of Natural Hazard by Earthquake**

S.O. 248(E) - Whereas, the issue of making suitable provision in the Building Bye-laws to ensure that the building that are erected in Delhi provide for the requisite safety feature in respect of natural hazard by way of earthquake has been under the consideration of the Government.

Whereas a Public Notice was issued and published in the newspapers on 10.2.2001 providing modifications/ additions which the Central Government intended in the Building Bye-laws, 1983. In all 51 objections/suggestions were received from the public and they were examined by a committee under the convenorship of Chief Planner of Town and Country Planning Organization.

Whereas after thorough consideration of the report Central Government has decided to make following modifications/additions in the Building Bye-laws, 1983;

Now, therefore, in exercise of the powers conferred by sub-section (2) of Section 11 A of Delhi Development Act, 1957, the Central Government hereby makes the following modifications/additions to the Building Bye-laws, 1983 with effect from the date of publication of this notification in the Gazette of India.

**MODIFICATIONS**

- (i) Clause 18 of Part-III (Structural Safety and Services) of the Building Bye-laws, 1983 will be modified as:

“The structural design of foundation, masonry, timber, plain concrete, reinforced concrete, pre-stressed concrete and structural steel shall be carried out in accordance with Part-VI Structural Design, Section-1 —Loads, Section 2— Foundation, Section 3 — Wood, Section 4 — Masonry, Section 5 — Concrete Section 6 — Steel of National Building Code of India, taking into consideration all relevant Indian Standards prescribed by Bureau of Indian Standards including the Indian Standards given in Annexure-A for earthquake protection of bindings”.

**Note:** Whenever an Indian Standard or the National Building Code is referred, the latest provision in the Standards should be adhered to”) (ii) An additional sub-clause is included under Clause 6.2.9 (Documents to accompany

- (ii) An additional sub-clause is included under Clause 6.2.9 (Documents to accompany application for building permit) of Building Bye laws follows:

“(i) The certificate as indicated as Annexure-B and C to be signed by the owner, the architect, and the Structural Engineer.”

**ANNEXURE 1A**

**List of Indian Standards/Guidelines for Hazard Safety**

For earthquake protection

1. IS: 1893-1984 “Criteria for Earthquake Resistant Design of Structures (Fourth Revision)” June 1986.
2. IS: 13920-1993 “Ductible detailing of Reinforced Concrete Structures subject to Seismic Forces-Code of Practice” November .1993.
3. IS: 13828-1993 “Earthquake Resistant Design and Construction of Buildings–Code of Practice (Second Revision)” October 1993.
4. IS: 13828-1993 “Improving Earthquake Resistance of Low Strength Masonry Buildings–Guidelines” August 1993.
5. IS : 13827-1993 “Improving Earthquake Resistance of Earthen Building - Guidelines” October.
6. IS: 13935-1993 ‘Repair and Seismic Strengthening of Buildings - Guidelines” November 1993.

Fig. 2 : MOUD Gazette Notification dated 21<sup>st</sup> March 2001 regarding earthquake safety of buildings

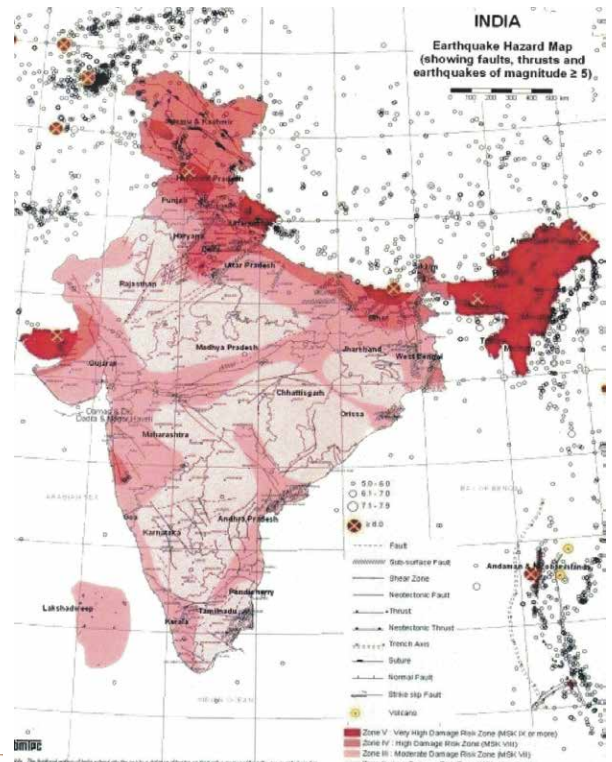


Fig. 3: India- Earthquake Hazard Map  
Source: BMTPC

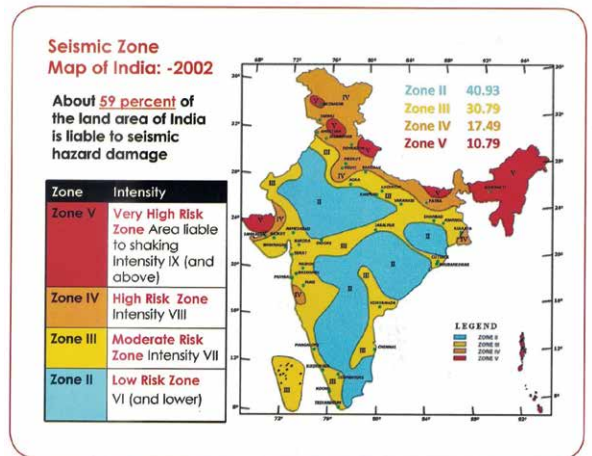


Fig.4: Seismic Zone Map of India  
Source: BMTPC

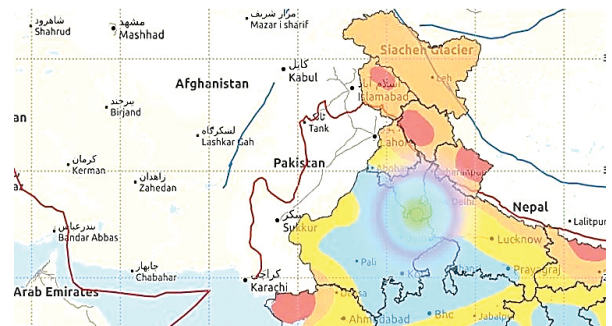


Fig. 5: Delhi Seismic Epicentre  
Source: Ministry of Earth Sciences

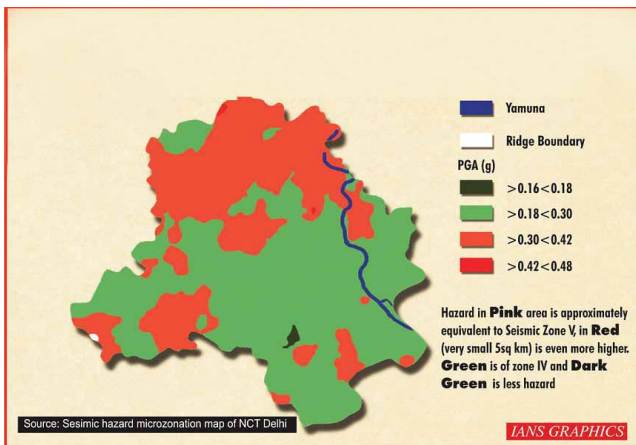


Fig. 6: Seismic Hazard Micro Zonation Map of NCT Delhi  
Source: Ministry of Earth Sciences

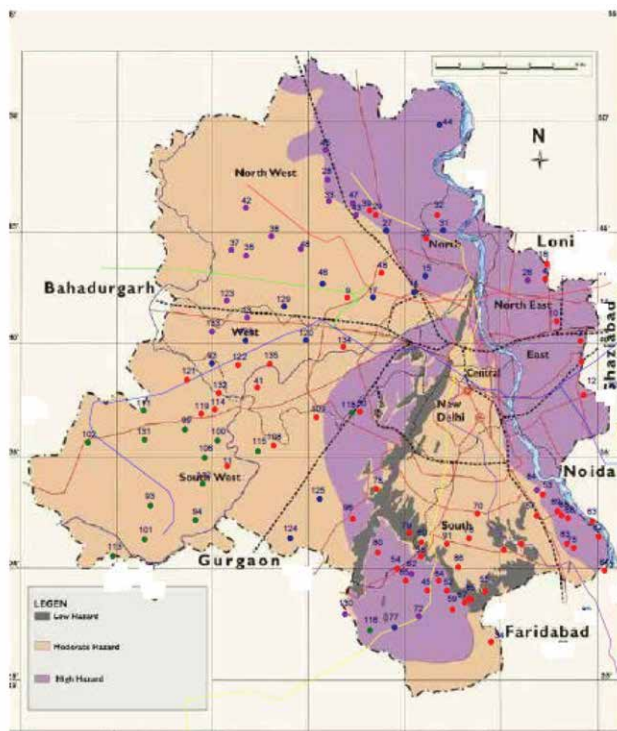


Fig. 7: Earthquake Microzonation Map of NCT, Delhi  
Source: Ministry of Earth Sciences

## Earthquake preparedness in Delhi

The Master Plan for Delhi 2021, notified in Feb. 2007 recognises that Delhi falling in Seismic Zone IV, in the past, had several earthquakes (Fig.8). Two major lineaments, namely Delhi-Haridwar ridge and Delhi-Muradabad faults pass through it, which have the potential of generating earthquakes of the magnitude up to 6.5 to 6.7. To mitigate the danger, areas of vulnerability be identified by micro zonation.

The MPD 2021 stipulates that the local bodies should update the building byelaws, besides adopting the following strategies:

a. Micro-zonation surveys should be referred for

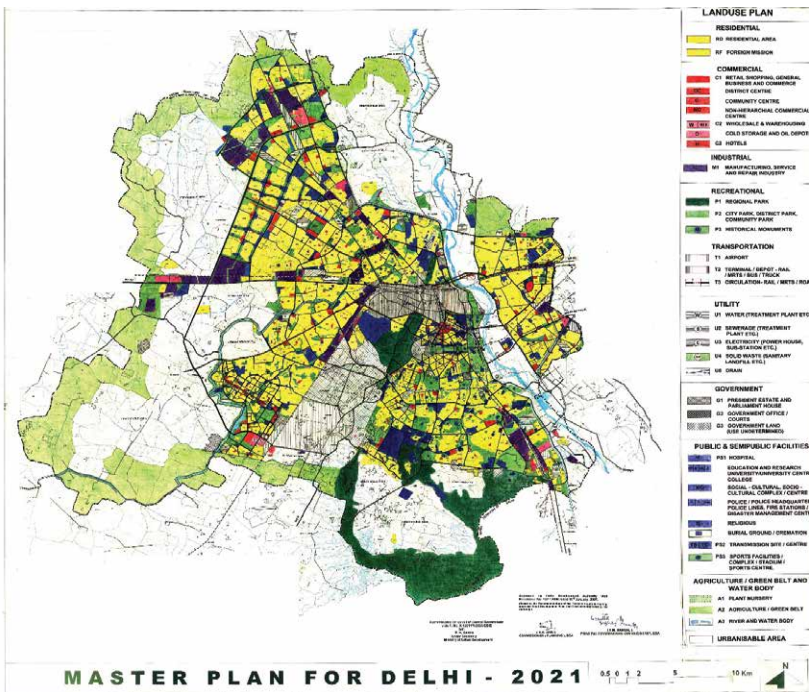
land use planning and be considered while preparing the Zonal Plans and Layout Plans.

- Seismic micro-zonation for selected areas having high growth rates should be taken up on priority.
  - On the basis of vulnerability studies and hazard identification, which includes soil conditions, probable intensity of earthquake, physiographic conditions of the area, fault traces, etc., local level land use zoning and planning should be undertaken.
  - Building bye-laws should incorporate the aspects of Multi Hazard Safety, and Retrofitting.
  - Priority should be given to public buildings (such as hospitals /tertiary health care centres], educational, institutional, power stations, infrastructure, heritage monuments, lifeline structures and those which are likely to attract large congregation) for their ability to withstand earthquake of the defined intensity.
  - Suitable action should be taken for retrofitting and strengthening of structures identified as vulnerable as per earthquake manuals and National Building Code. A techno-legal regime has to be adopted for provisions on Multi Hazard Safety aspects.
- b. Delhi Fire Services being the nodal agency for disaster management should identify vulnerable areas such as areas with high density and poor accessibility in the city and propose suitable measures. Proposed Disaster Management Centres should be established in every zone to deal with the disasters, including bio-chemical and nuclear disasters. The key communication centres should be protected from natural disasters, i.e. flood, fire and earthquake etc. and services restoration should be taken up on top priority.
- c. Sensitize people, particularly school children, about after effects of disaster.
- d. Make people aware through media campaigns and advertisements about emergency procedures and location of emergency shelters etc.

According to MPD 2021, ‘Special Area Building Regulations be framed for Special Area, unauthorized regularized colonies and village abadis. Owners in Special Area, unauthorised regularized colonies and village abadi shall register themselves with the Local Body within the next six months (i.e. by August 2007). They will also submit a certificate of structural safety by qualified engineers. Owners / occupiers of properties beyond 15 m height may bring the structure within prescribed height by 30th June, 2009’.

Besides Delhi Master Plan, The Delhi Disaster Management Plan prepared by DDMA and the NCR Plan prepared by the NCRPB, also suggest the adoption of the following measures:

- Panic buttons/SOS mobile App
- Video analytics enabled City Centre and Operations Centre
- Helplines
- Integrated Command and Control Centre (ICCC)
- Community/ Voluntary Network



## Disaster Risk Reduction (DRR)

At the international level, India has been playing a leading role in the field of disaster risk reduction and has committed a contribution of \$ 6 billion for DRR mitigation and \$ 23 billion for preparedness, response and recovery during 2021-25. This was announced at the Sendai framework review meeting at the United Nations in May 2023. India has also set the priorities of DRR for G 20 Nations, viz. early warning for all, resilient infrastructure, improving finances and capacities for DRR response and eco-system-based approaches to DRR.

## The gaps

In spite of extensive techno-legal and institutional work, Delhi is still precarious and unsafe. Out of 46 lakh odd buildings, the MCD has identified only 4655 buildings for structural audit, retrofitting or demolition. The MCD notice for submission of structural safety certificate, issued after High Court Order (2020) has not been implemented (Fig. 9). There is no comprehensive documentation of the buildings in the city. The responsibility of structural audit on the owner has not worked. The incentives of FAR /TDR and subsidy/loans are not available for redevelopment, retrofitting and repair of dangerous, dilapidated and non-engineered structures. This also raises the issue of political interventions, and whether the enforcement of the building regulations can be made a quasi-judicial process.

## Strengthening basic data and leveraging new technologies

A major barrier is lack of up-to-date geospatial data of the buildings. The records of the ULBs are chaotic and inaccessible. These need to be organised by using new technologies, keeping in view the earthquake and disaster risk reduction, as given below:

It is generally not the natural hazards per se that kill people, rather unsafe

Fig. 8: Master Plan for Delhi 2021  
Source: DDA

Fig. 9: MCD Public Notice dated 19<sup>th</sup> June 2020 for safety of buildings against earthquakes

**Table 1: New Technologies for Earthquake/Disaster Risk Reduction**

Phase	Activities	Example Technology
Mitigation	<ul style="list-style-type: none"> <li>Geospatial data of built environment</li> <li>Baseline information of natural ecosystem</li> <li>Land use planning and risk management</li> <li>Community engagement</li> </ul>	<ul style="list-style-type: none"> <li>Remote sensing for documentation of all the buildings, location, age, plans, category and land use</li> <li>Computer modelling of risks and vulnerability</li> <li>Drone supported surveys</li> <li>Satellite and GIS to map natural ecosystems</li> <li>Model and land use changes</li> <li>Real Time warning systems using mobile phone</li> <li>Mobile apps for local communication</li> <li>Information campaign via digital media</li> </ul>
Preparedness	<ul style="list-style-type: none"> <li>Meteorological observation</li> <li>Spatial Mapping</li> <li>Early warning Systems</li> <li>Stockpiling</li> <li>Identifying vulnerable buildings and infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>IoT connected and AI enabled monitoring</li> <li>Satellite based technologies to gather geospatial and meteorological data</li> <li>Digital mapping, GIS, Open Street Maps, hazard maps</li> <li>Real Time monitoring of risks</li> <li>AI enabled cross checking of data</li> <li>Mobile based warning apps</li> <li>Digital communication systems to inform people</li> <li>AI enabled forecasting, digital accounting, and monitoring tools</li> <li>Digital inventory of stockpiles</li> <li>Geospatial surveys using software such as Open Data Kits</li> </ul>
Response	<ul style="list-style-type: none"> <li>Emergency services such as search and rescue evacuation</li> <li>Provision of shelters and basic needs</li> <li>Surveillance</li> <li>Communication</li> </ul>	<ul style="list-style-type: none"> <li>Drones for aerial surveillance</li> <li>Social media monitoring</li> <li>Geospatial maps</li> <li>Apps to inform people about shelter facilities</li> <li>Communication infrastructure</li> <li>GIS mapping and aerial surveillance</li> <li>Broadcasting emergency messages on mobile phones</li> <li>Social media platforms</li> </ul>
Recovery	<ul style="list-style-type: none"> <li>Livelihood support</li> <li>Establishment and rehabilitation of basic services</li> <li>Reconstruction</li> <li>Planning</li> </ul>	<ul style="list-style-type: none"> <li>Cash transfers via electronic/digital tools</li> <li>Real-time updates on the restoration of services</li> <li>Digital tools to coordinate processes, construction and operations.</li> <li>Digital surveys, mapping and monitoring using drones</li> </ul>

Source: Author

buildings and construction that leads to loss of life and property. Both the Spatial and non-spatial data are abstracted and synthesised to prepare a comprehensive District Hazard Risk Map. This also helps to frame earthquake hazard in a comprehensive perspective (Fig. 10).

### Risk assessment

Various engineering organisations and academic institutions, such as IIT (Kanpur), CBRI (Roorkee), SERC (Chennai), BMPTC, etc. have worked extensively to provide useful guidelines to safeguard the buildings from seismic damage. Table 2 details out the earthquake loss susceptibility for different construction types. Table 3 indicates the categories of seismic damages and suggests the empirical measures.

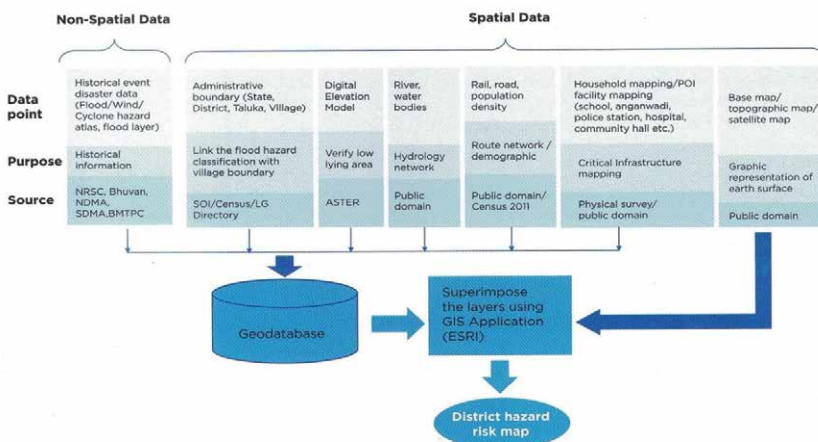
### ABCDE of safe construction

The basic principle of safe construction can be summed up as ABCDE, as given below (Fig. 11):

- A – Anchorage
- B – Bracing
- C – Connections
- D – Detailing
- E – External Environment

The critical action areas for safer buildings encompass the following:

- i. Incentives for public and private sectors, such as, adjustment of insurance premia, loan or loan-cum-subsidy schemes.
- ii. Technology Transfer for non-engineered structures.
- iii. Buildings should be constructed on solid ground, preferably a frame structure with interlocked walls and floors that can withstand the lateral forces during an earthquake.
- iv. Materials must have sufficient ductility to withstand the stresses during earthquake shaking.
- v. Reinforcement of structure and columns must contain sufficient transverse, tied or spiral arrangements to withstand repeated distortion during earthquakes.



Source: Illustration provided by Senthilkumaran Krishnan and the Reliance Foundation disaster management team.

**Fig. 10: Process of creating District Hazard Risk Map**

Source: Ganguli, Mithun, 2003, Enabling Disaster Preparedness with Geospatial Data, ORF, New Delhi

vi. Retrofitting of existing buildings and structures should be undertaken along with essential Services, water supply, transportation and communication.

concrete pillars, beams, slabs, balconies, chajjas, staircases, etc., whenever necessary, reinforcement steel may be replaced, along with strengthening of the joints, supports, walls, pillars, etc.

the ground. These act as the shock absorbers and prevent building damage from an earthquake (Figs. 12 & 13).

Stone masonry is vulnerable against earthquake forces unless it is used with necessary earthquake resistant features, in accordance with the BIS 154326:1993 code of Practice for Earthquake Resistant Buildings, IS 4326 and IS 1597(part 2): 1992. Besides slenderness ratio of the wall (height or length / thickness), eccentricity of vertical load and openings affect the performance of masonry. The masonry units must conform to IS 1077:1992 and IS 2185(Part I). Use of through stones, bond stones and steel reinforcement are recommended for earthquake resistant masonry (Figs. 14 and 15).

Many of the key adaptations to earthquake risks require individual and collective action at the community-level, which are undertaken incrementally.

## Conclusions

Delhi has a large numbers of unsafe structures all over (fig: 16,17). The apprehension that whether Delhi would withstand an earthquake of 7 magnitude similar to that occurred in Turkey and Syria this year needs to be pondered upon seriously. No doubt that since Gujarat earthquake, 2001 much has been done on the technical and legal fronts and organisational capacity building, still two major gaps exist:

- i. Database of each and every structure and
- ii. The enforcement of building/ structural Standards.

In spite of the court orders, Delhi has failed on these counts. This may cause a catastrophe unless rapid action is taken on this front and it may be considered whether the enforcement of the building regulations can be made a quasi-judicial process.

Usually, in old buildings due to rust and dampness, the steel may get corroded, and concrete may lose strength and become prone to damage because of ageing, fires, structural failure, overloading, vibrations and earthquakes. As such, it is necessary that structural audit is undertaken for the structures older than 50 years. For repair of

## Base isolation and seismic dampers

To protect buildings from damaging earthquake effects, Base Isolation Devices and Seismic Dampers can be adopted to detach (isolate) the building from

Table 2: Earthquake loss susceptibility data for different construction types (MM = Modified Mercalli scale)

Category of Damage	Extent of Damage	Remedial Measure
A. Slight Non-structural Damage	Fine cracks in plaster, fall of small pieces of plaster	Only architectural repairs needed
B. Moderate Structural Damage	Small crack in walls fairly large pieces of plaster states slip off, cracks in parapet, walls	Architectural repairs to achieve durability.
C. Heavy Structural Damage	Large and deep cracks in walls, chimneys fall, load carrying capacity of the building is partially reduced.	Building needs to be vacated and reoccupied only after structural restoration and seismic strengthening.
D. Severe Structural Damage	Gaps in walls, parts of buildings may collapse separate parts of building lose cohesion and show relative movement, inner walls collapse. Approx. 50 per cent of the main structural elements fail	Building has to be vacated. Either the building has to be demolished or extensive structural restoration and seismic strengthening work has to be undertaken.
E. Collapse	Total Collapse of building	Clearing site and reconstruction.

Source: BMTPC

Table 3: Categories of Seismic Damages

S.No. Construction type	Average damage(%) at intensity (MM)				
	VI	VII	VIII	IX	X
1 Adobe	8	22	50	100	100
2 Unreinforced masonry, non-seismic design	3.5	14	40	80	100
3 Reinforced concrete frames, non-seismic design	2.5	11	33	70	100
4 Steel frames, non-seismic design	1.8	6	18	40	60
5 Reinforced masonry, medium quality, non-seismic design	1.5	5.5	16	38	66
6 Reinforced concrete frames, seismic design	0.9	4	13	33	58
7 Sheer wall structures, seismic design	0.6	2.3	7	17	30
8 Wooden structures, seismic design	0.5	2.8	8	15	23
9 Steel frames, seismic design	0.4	2	7	20	40
10 Reinforced masonry, high-quality seismic design	0.3	1.5	5	13	25

Source: BMTPC

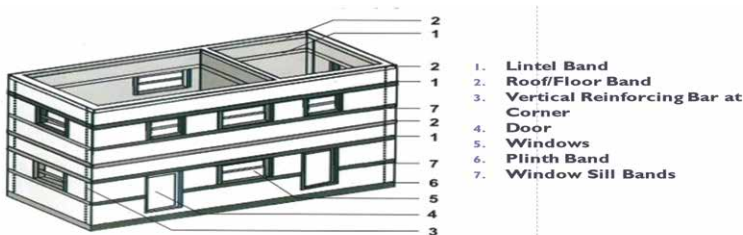


Fig. 11: An earthquake safe structure integrates Anchorage, Bracing, Connection, Detailing and External Environment

Source: BIS, IS 4326-1993, and Arya, Anand (1993) BIS, New Delhi



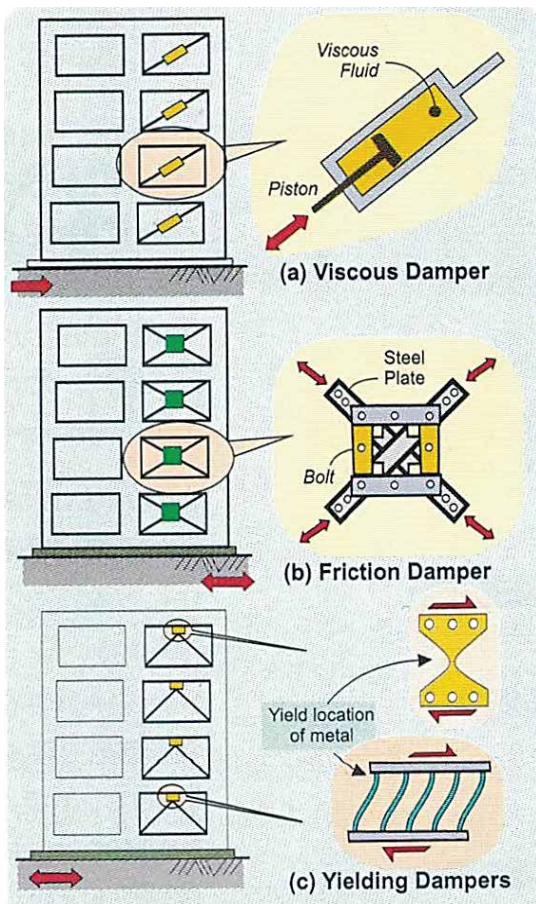


Fig. 12: Seismic Energy Dissipation Device Each device is suitable for certain building  
 Source: Murty CVR (2005) Earthquake Tips

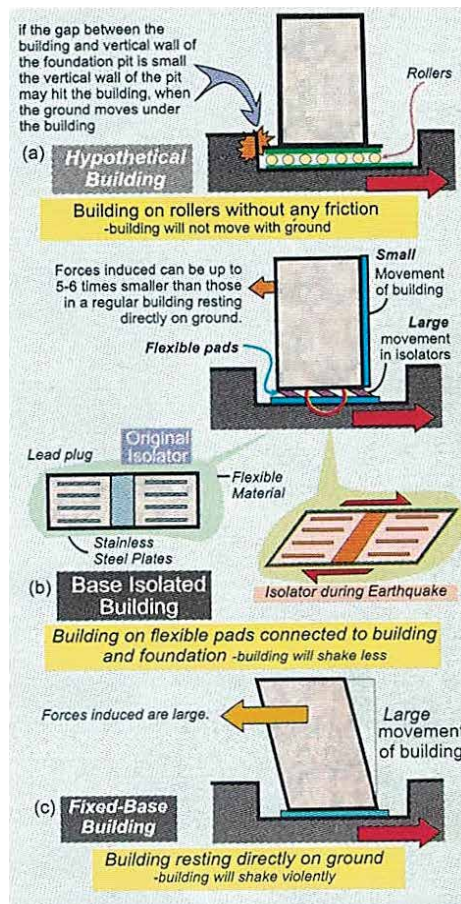


Fig. 13: Building on flexible support shakes lesser, this technique is called base isolation  
 Source: Murty CVR (2005) Earthquake Tips

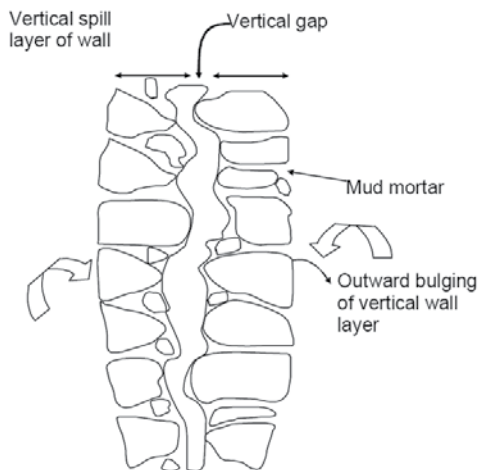


Fig. 14: Schematic wall section of a traditional stone house – thick walls tend to split into vertical layers.  
 Source: Building Materials & Technology Promotion Council (BMTPC), New Delhi

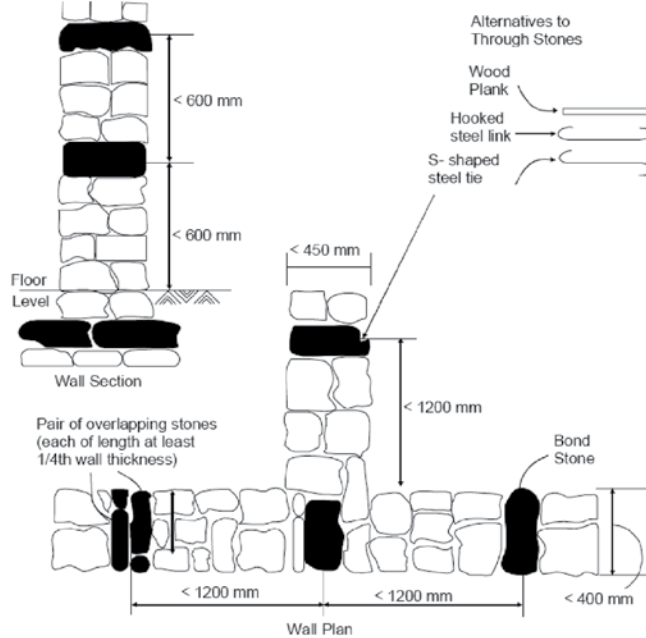


Fig 15: Use of "through stones" or "bond stones" in stone masonry walls prevent the wall from separating into wythes.  
 Source: Jain, A.K. (2007) Handbook on Disaster Management, Pragun Publication, Delhi.

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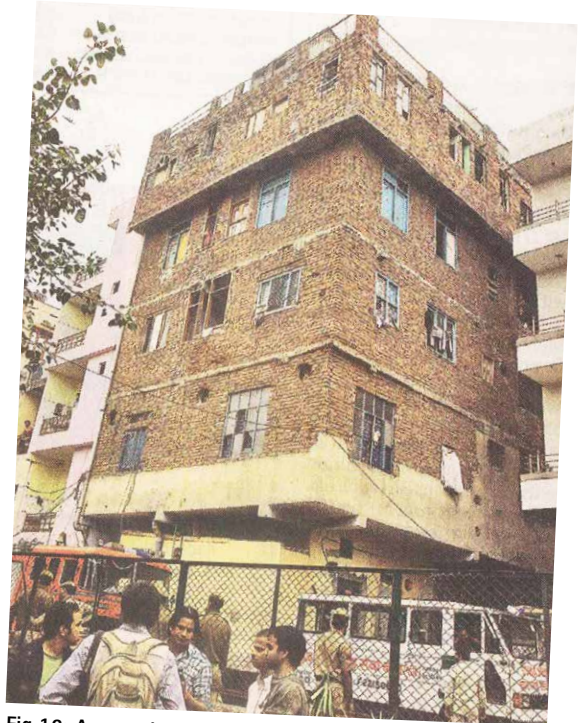


Fig 16: A precarious and unsafe building in Lalita Park, East Delhi



Fig 17: A leaning four-storeyed building at Mahavir Enclave in West Delhi

# GIS mobile application for crime reporting and monitoring

This study provided the police officers in the La- Dade Kotopon district Police headquarters with a user-friendly software for capturing crime data based on spatial location in real-time for hotspot maps, crime detection, classification, crime spatial dissemination and allocation of resources



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## Abstract

The study utilised Geospatial technology for capturing crime data based on spatial location for monitoring, evaluation and spatial analysis of crime-related data. Understanding the spatial trends of crime prevailing in La-Dade Kotopon municipality, have the potential to depict how to formulate and enforce critical decisions to curb cases of crime in the area. Several database management systems have been implemented by the Ghana Police Service to aid in monitoring crime but the use of Geographic Information Systems within the Ghana Police Service is yet to be implemented fully across all jurisdictions. For this reason, the crime data and statistics report published by the Ghana Police Service do not include maps depicting the crime locations and crime hotspots zones. This has made many people fall victims of various types of crimes at the same places where those crimes occur rampantly. In this study, a geospatial mobile and web application have been developed to capture, monitor and analyse crime data in the municipality. The results of this study showed that, a total of 293 crime cases were recorded for the second quarter of the year 2020. Out of the total, 84 for April, 127 for May and 82 cases for June. Hotspot area for Assault cases in the municipality was La. Tse-Addo was hotspot area for Robbery, rape and Land guards activities/Trespass. Aviation Park was also the hotspot for Possession of Narcotic drugs. The hotspot area for issue of dud cheque crimes was South La. Furthermore, hotspot zone for stealing, threat of harm, offensive

conduct, causing unlawful conduct, failing to comply with Restriction orders was La. In recommendation, social media should be used to warn and sensitise the public on dangers and crimes.

## Introduction

Modern societies have been bedevilled with increasing crime rate which causes loss of lives and properties. Several conventional methods of data collection to help combat crime have been implemented, but in this era of advanced computer technologies, the introduction of Geographic information System (GIS) has led to crime-fighting agencies to develop sophisticated models in combating crimes. In reference to the Ghana Criminal Code 1960, ACT 29, a crime is any unlawful act which causes harm to lives and property. It is punishable by death or imprisonment or fine and constitutes a criminal offense against a person or the state. Throughout history, individuals have attempted to understand why a person will commit crimes. Some consider criminal acts to be lucrative than a normal job.

One of the major problems in solving crimes are the lack of spatial data and associated attributes of the crime and for this reason, it becomes difficult to visualize the exact locations of the various crimes on maps. The Ghana Police Service (GhPS) have implemented some computer technologies for crime database management which include an automated criminal records database, fingerprint identification system (The Criminal data Services Bureau-Ghana

Police Service, 2011) and the Case Tracker Software (Crime and punishment, 2018). However, despite the implementation of these database systems, GIS is yet to be implemented fully across all jurisdictions of the GhPS. As a result, the crime data and statistics report published by the Ghana Police Service do not include maps depicting the crime locations and crime hotspots zones. This has made many people to fall victims to various types of crimes at the same places where those crimes occur rampantly.

In the works of Amissah *et al.* (2014), GIS was used at the Dansoman Police subdivision in Accra, Ghana to prepare crime maps and examine the spread of crime. Crime data received from the police lacked spatial reference. In view of this, handheld Global Positioning System devices were used to capture the geolocation of the various crime sites. In conclusion, the researchers averred that crime data should include both spatial and attribute data to assist in GIS crime analysis in future studies.

Adepoju *et al.*, (2014) used GIS during the ASPRS 2014 Annual Louisville Conference in Kentucky on March 23-28, 2014 for crime hotspot mapping and analysis using Abuja State as a case study in Nigerian urban security and crime management. The result showed significant correlation between parks and gardens and crime as well as positive correlation between slum settlement and crime in the study area.

Arhin and Duffour (2015), GIS was used to generate Graduated symbols, stacked chart, proportional symbol and pie chart methods for hot spot analysis on KNUST campus. In their research, the crime data obtained from the university’s security department lacked coordinates, hence the spatial data of the mean centre of the crime sites were captured using Google Earth software. The researchers created a web application which will enable users to report crime incidences on KNUST campus.

Ghartey and Gyabeng (2017) developed an updated interactive web-based map with geocoded address for KNUST campus using GIS technologies such as ArcGIS software, ArcGIS Online and the Web AppBuilder, which enabled users to find paths to specific locations on campus. However, this platform also provided safety information to students, notifying them about the crime spot on campus, the incidence recorded on crime at various spot and information on security emergency dial up numbers and checkpoints, to help fight and reduce crime on KNUST campus.

Prakruthi Prakasha *et al.*, (2018) developed a web-based criminal record system (CRS) using mobile devices with regard to traditional GPS devices in order to enable the police to capture the location of the criminal activity. This online crime detection method was built to mitigate the challenges and hardships that remain in the conventional manual system of practice.

In terms of violence, focused crime zones are often alluded to as crime hotspots (McLafferty *et al.*, 2000). In other words, a crime

hotspot is an area with a greater than usual number of violent crimes. The places with more criminal occurrences are described as hot and as such, places with less occurrences will be described as cool. This is due to the that fact crime is randomly distributed spatially. (Eck *et al.*, 2005; Chainey and Ratcliffe, 2005).

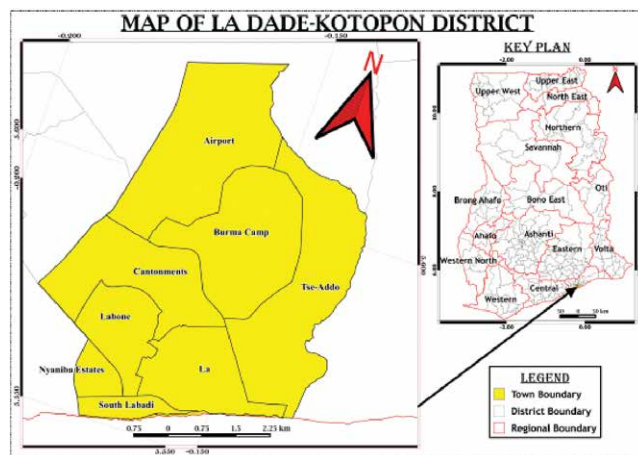


Fig. 1 Map of La Dade-Kotopon Municipal

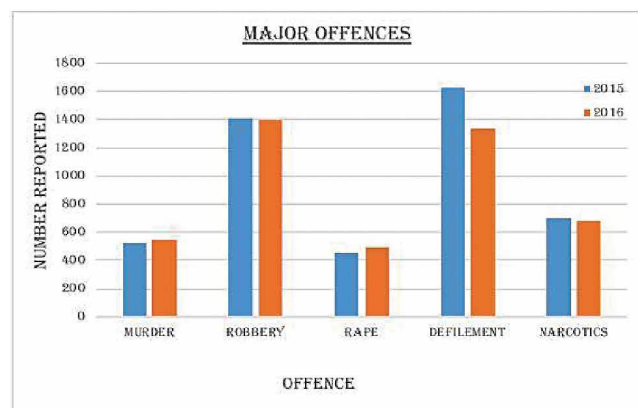


Fig. 2 Graphical Representation of Major Offences Committed



Fig. 3 Design Tools

This article seeks to map crime data, identify hotspots and present patterns using GIS technologies to enhance data collection, visualization and informed decision making. Graduated symbol maps were used to represent the types of crime prevalent in La Dade Kotopon municipality. By so doing, our contribution is an extension of the application of mobile and web GIS technologies in preventing and combating crime. These were achieved by addressing these concerns:

- i. Determine the spatial locations of crimes
- ii. Provide a spatial database system for crime records.
- iii. Use GIS spatial analyst tools to analyse and identify crime hotspots.

### Study area

The study was carried out in the La-Dade Kotopon municipality. It covers an area of 36.08 km<sup>2</sup> (13.93 sq. mi) and lies within Latitudes 005°34'19"N and 005°35'27"N and Longitudes 000°11'20"W and 000°7'55"W as shown in Fig. 1. According to the Ghana Statistical Service report (2021), It recorded a population of about 140,264 with 51.4% females and 48.6% males. The area is entirely urban and has a 66.6% young population, reflecting a large base population pyramid that tapers off with 3.9% with a limited number of elderly residents (65+ years). The average age dependence ratio is 70.5%; the infant dependency ratio is higher (66.6 % than that of the old age dependency ratio 3.9).

### Ghana police service and crime report

The Ghana Police Service is the main law enforcement agency of the Republic of Ghana and is under the jurisdiction of the Ghana Ministry of Interior. The mandate of the Police Service is to maintain law and order throughout the territorial boundaries of Ghana (Police service Act, 1970, Act 350). Some of their duties are: Crime detection and prevention, apprehension of offenders, maintenance of law, order public and safety of persons and properties and due enforcement of the law. (<https://police.gov.gh/>, retrieved on 5th September, 2020).

**Table 1 Commonly Committed Offences**

OFFENCE	NUMBER REPORTED(YEAR)		% CHANGE
	2015	2016	
Assault	55,624	59,158	6.4
Stealing	49,739	54,802	10.2
Threatening	19,662	22,590	14.9
Fraud	16,491	17,667	7.1
Causing damage	9,507	11,012	15.8
Causing harm	3,299	3,123	-5.3
Unlawful entry	1,588	1,201	-24.4

**Table 2 Major Offences Committed**

OFFENCE	YEAR		% CHANGE
	2015	2016	
Murder	525	549	4.6
Robbery	1,411	1,397	-1.0
Rape	451	497	10.2
Defilement	1,630	1,341	-17.7
Possession, use and distribution of narcotic drugs	698	681	-2.4

For research purposes, a sample of a Standard Ghana Police Crime Report in the year 2015 and 2016 as presented in Fig. 2 and Tables 1 and 2 to illustrate how the Ghana Police service report crime data (Source: Statistics & Information Technology Unit (SITU), CID Headquarters, Accra). All the Commonly Committed Offences registered increased with the exception of causing harm and unlawful entry, which showed decreases of 176 and 387 cases representing 5.3% and 24.4% respectively. As usual, Assault emerged as the most highly Committed Criminal Offence in the country. However, the hotspot locations lack spatial data representations as earlier mentioned.

## Resources and methods used

### Materials

The criteria requirements were studied and the software design was carried out. Fig. 3 illustrates the design tools used for the study. they include Sublime Text (text editor), Geoserver (for hosting the web maps), Xampp server (for hosting web application), Android Studio (for developing mobile app), Kotlin (for android), Hypertext Preprocessor (for web), Structured Query Language

(for database), Secure Sockets Layer (protocol for web browsers and servers for encryption, authentication, etc.). Moreover, Open Street Map (OSM) was used as the base map, fig. 8 and fig. 9 describes the interactive web map platform. It enabled the officer to digitally visualize locations of all the various crimes cases.

### Methodology

Waterfall model was used in the software development model. It follows the sequential order of development where one phase is completed before the start of another. This model frequently focuses on early-stage planning and is used in initiatives where all the criteria for the framework are defined (Govardhan, 2010). The stages adapted by this project from the waterfall model includes:

- i. Analysis of specifications: Requirements for the software to be used were obtained. These requirements were gathered in direct consultation with the District Police Crime Officer.
- ii. Functional Requirements: Specific functions expected of the application to be carried out were examined. The framework of the app included:
  - a. Police officers were allowed to report incidents of crime.
  - b. Police officers were allowed to generate statistical charts and hotspot maps.
  - c. Police officers were allowed to view on a map the locations of reported crime.

### User requirements

The user specifications define tasks performed on the mobile phones and computers by the users. The Station officer, District crime officer and System Administrators were the users of the software. The specifications for these users were illustrated a use case diagram as given in Fig.4

Flow diagram for the operation procedures of crime data collection, monitoring and evaluation is presented in Figs. 5 and 6.

In future research, crime data based on spatial location should be collected over a long period to determine the spatial trends of crime within the municipality instead of the short period used in the data collection of this research

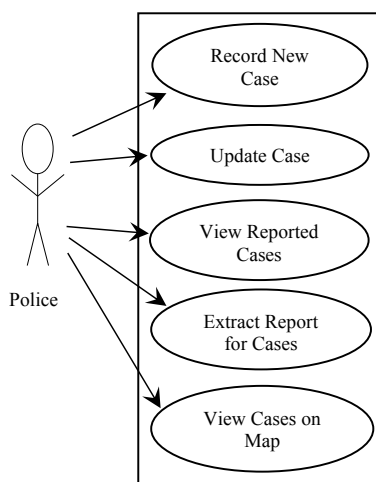


Fig. 4 Use Case Diagram



Fig. 5 I-Report App

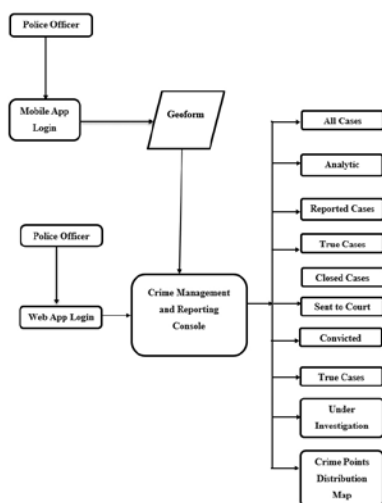


Fig. 6 Flow Diagram

### Data collection

The Mobile app as shown in Figs. 7, 8 and 9 were used to record crime spatial and attribute data when crime cases were reported. The process involved an officer being enrolled onto the central system and then provided with credentials to access the mobile. The officer logged into the application with his Police identification number. The app was used to capture crime data which include: geolocation, type of crime/offence, complainant details (name, gender, age nationality), suspect details (name, gender, age, nationality), time and date. Upon completion, the data is stored in the cloud in a secured database which can be accessed either on the mobile device or computers by the app administrators.

## Results and discussion

### Data analysis and output

The web portal helped cases from crime scenes to be viewed, updated and analysed. Figs. 10, 11 and 12 enabled the officer to perform graphical statistical analytics using charts such as bar, pie and line charts. The reported crime cases were automatically quantified into case types and number of cases reported and locations data noted. In addition, Fig. 13 enabled the officer to view the list of cases reported. In view of this, updates on the cases are effectively done where necessary. The output enabled the officer to view the demographic information of the crime suspect and the complainant which include name, gender, nationality, age, date and time.

Figs. 14 and 15 also enabled officers to visualize crime cases on an interactive web map.

The results of this study showed that, a total of 293 crime cases were recorded for the second quarter of the year 2020 as shown in Table 3. Out of the total, 84 for April, 127 for May and 82 cases for June. Assault cases were identified to be a general problem in the municipality. Consequently, La was the major hotspot for assault followed by Tse-Addo. Hotspot area for robbery and rape, Land guards/Trespass was Tse- Addo. Aviation Park is also notified for Possession of Narcotic drugs. The hotspot area for issue of false cheque crimes was South La. Furthermore, hotspot zone for stealing, threat of harm, offensive conduct, causing unlawful conduct, failing to comply with Restriction orders was La. The data were used to prepare graduated symbol maps to depict crime hotspot areas as shown in Figs. 16, 17 and 18 using QGIS software to enhance map visualization and inform decision making.

## Conclusions and recommendations

### Conclusion

This study provided the police officers in the La- Dade Kotopon district Police headquarters with a user-friendly software for capturing crime data based on spatial location in real-time for hotspot maps, crime detection, classification, crime spatial dissemination and allocation of resources. GIS mobile and web application were developed to satisfy the aim and objectives of the study with various functional tools or widgets configured. Hotspot analysis were made using proportion symbol maps to enhance visualization. The use of this tool helped to identify crime hotspots and enhanced effective crime spatial planning and analysis in the La-Dade Kotopon municipality.

### Recommendation

- i. Users of the mobile app should visit the crime scene before capturing the data. This will assist in identifying the exact location of crimes.

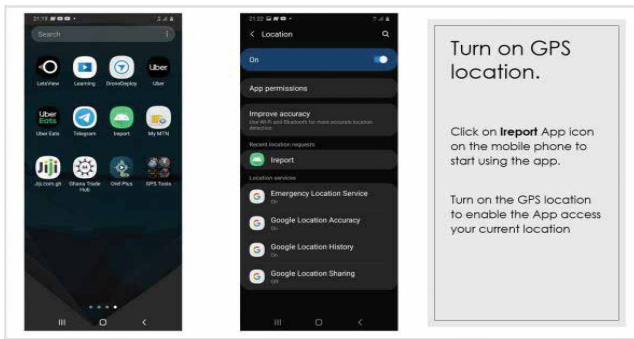


Fig. 7 Officer Mobile App

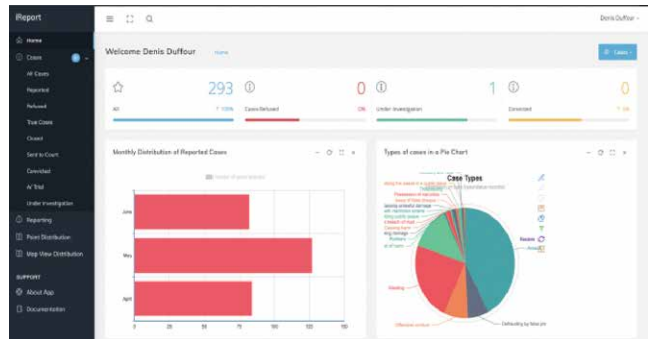


Fig. 11 Crime Case Analytics Graphs

Police Officer

Crime data collection form.

Case Complainant Details

Choose Case Type

Name of Complainant

Gender of Complainant

Age of Complainant

Nationality of Complainant

Suspect Details

Name of Suspect

Gender of Suspect

Age of Complainant

Fig. 8 Officer Mobile App Geo-Form

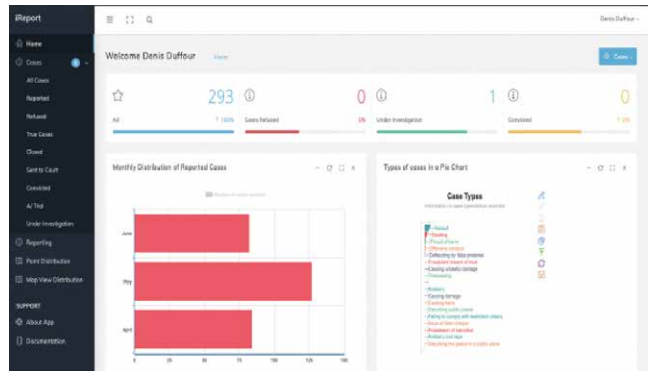


Fig. 12 Crime Case Analytics Graphs

Police Officer

Crime data collection form.

The spatial data of the crime site is captured automatically.

Data recorded are used for crime hotspots analysis, monitoring and evaluation for informed decision making.

Case Complainant Details

Choose Case Type

Name of Complainant

Gender of Complainant

Age of Complainant

Nationality of Complainant

Suspect Details

Name of Suspect

Gender of Suspect

Age of Complainant

Nationality of Suspect

SAVE

DELETE

Fig. 9 Officer Mobile App Geo-Form

ireport

Cases Summary

List of Cases

Type	Complainant Name	Complainant Sex	Complainant Age	Complainant Nationality	Suspect Name	Suspect Sex
Assault	JOEL MATEO	male	59	Guatemalan	LUIS	male
Assault	AGUSTIN LUNA	male	45			
Assault	GOSION GIBOWOYO	male	52	Togolande	Bright Joe	male
Assault	BERNARD SAMFONG	male	49	ghanaian	Wakan Apodo	male
Assault	LEUNGOTONE LANGSON	male	37	ghanaian		
Assault	ADJOUROU-KOATE DENNIS	male	27	ghanaian		

Fig. 13 List of Cases

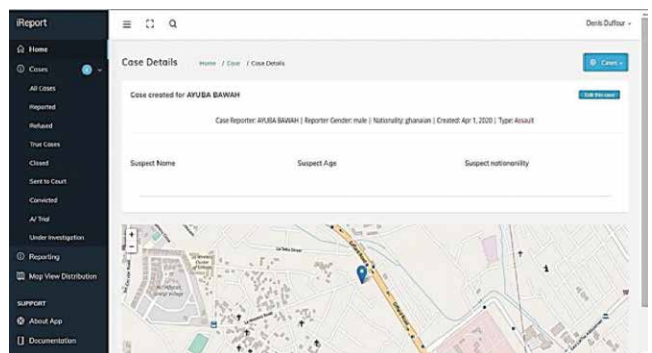


Fig. 14 Visualise Individual Crime Cases on Interactive Web Map

- ii. The mobile and web application should have access to internet and Global Positioning System (GPS) embedded in the mobile to enable the application to function
- iii. In future research, crime data based on spatial location should be collected over a long period to determine the spatial trends of crime within the municipality instead of the short period used in the data collection of this research.
- iv. Spatial information on crime hotspot areas should be made available to the general public. This will ensure that people do not fall victims of the same crime at the same places thereby reducing the crime rates in our communities.

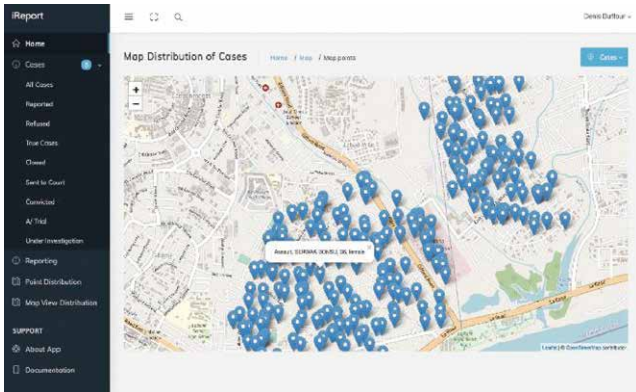


Fig. 15 Visualise All Crime Cases on Interactive Web Map

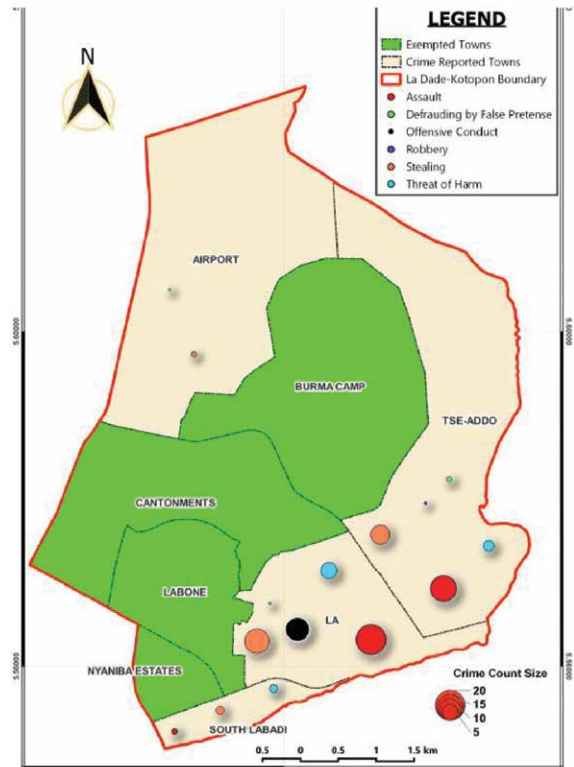


Fig. 16 Map Showing Proportional Distribution of Reported Crime Cases in April, 2020

Table 3 Summary of Monthly Report

CRIME TYPE	APRIL		MAY		JUNE	
	COUNT	HOTSPOT	COUNT	HOTSPOT	COUNT	HOTSPOT
Assault	36	La	62	La	29	Tse-Addo La
Stealing	21	La	29	La	18	La
Threat of Harm	13	La	14	La	10	La
Offensive Conduct	9	La	8	La	6	La
Defrauding by False Pretense	4	Tse-Addo La	8	Tse-Addo La	8	Tse-Addo La
Robbery and Rape	1	La	0		1	Tse-Addo
Fraudulent Breach of Trust	0		2	Tse-Addo	2	Tse-Addo
Causing of Harm	0		1	La	0	
Causing Unlawful Damage	0		1	La	3	La
Failing to comply with Restriction orders	0		1	La	0	
Possession of Narcotic drugs	0		1	La	1	Aviation Park
trespassing	0		0		3	Tse-Addo
Issue of false cheque	0		0		1	South La
<b>TOTAL</b>	<b>84</b>		<b>127</b>		<b>82</b>	

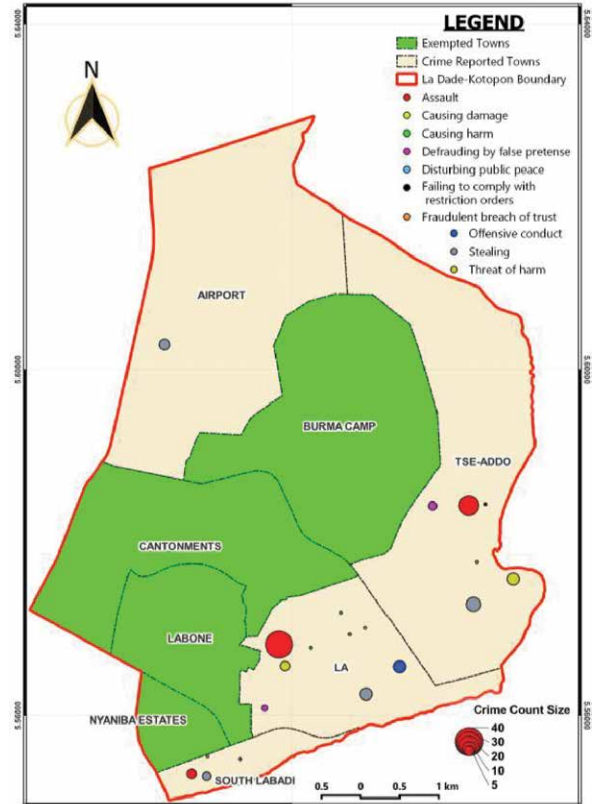


Fig. 17 Map Showing Proportional Distribution of Reported Crime Cases in May, 2020



- v. The use of Geospatial Technology should be integrated into the operations of the Ghana Police Service. These include mobile and spatial database management systems as demonstrated in this research. This application will help combat crime by assisting them to locate the exact position of the various crimes present in their jurisdiction.

## Acknowledgements

Acknowledgement to DSP. Joseph A. Afoakpah and all other staff members of La District Police Headquarters for the warm welcome and also assisting the researchers with the data collection.

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*The paper, originally published in Ghana Journal of Technology, Vol. 6, No. 2, pp. 20 - 27, is republished with the authors' consent* ▽

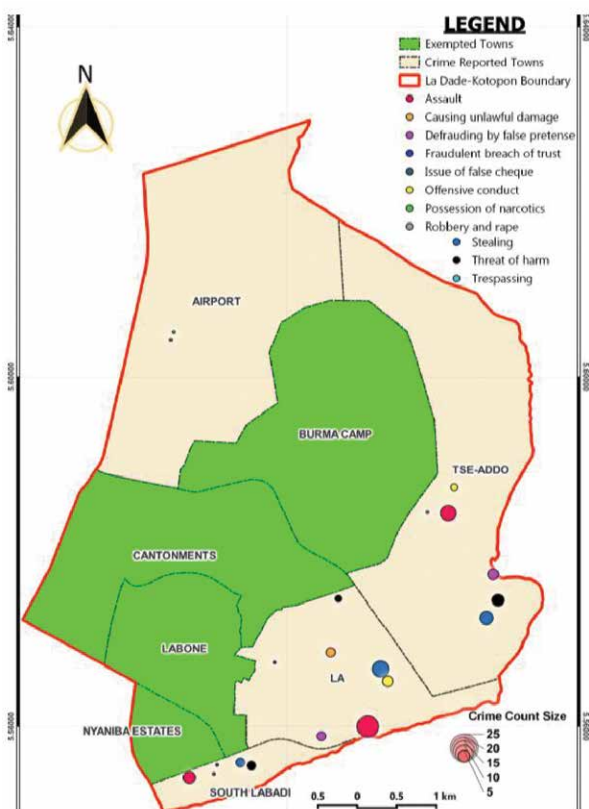


Fig. 18 Map Showing Proportional Distribution of Reported Crime Cases in June, 2020

# Spatial AI: how drones navigate

People are able to perceive their surroundings in three dimensions and can quickly spot potential danger in everyday situations. Drones have to learn this. Prof. Dr. Stefan Leutenegger, principal investigator and leader of the innovation field artificial intelligence at the Munich Institute of Robotics and Machine Intelligence (MIRMI), refers to the intelligence needed for this task as ‘spatial artificial intelligence’, or spatial AI. This new approach will be used by cartographers mapping forests, in ship inspections and when building walls.

In humans, it is entirely automatic: they recognize objects and their characteristics, can assess distances and hazards, and interact with other people. Stefan Leutenegger speaks of a coherent 3D representation of the surrounding area, yielding a uniform overall picture. Enabling a drone to distinguish between static and dynamic elements and recognize other actors: that is one of the more important areas for Prof. Stefan Leutenegger.

## Spatial AI, step 1: estimate the robot’s position in space and map it

Prof. Leutenegger uses spatial AI to provide a drone with the necessary on-board intelligence to fly through a forest without crashing into fine branches, to perform 3D printing or to inspect the cargo holds of tankers or freighters. Spatial AI is made up of several components that are adapted to specific tasks. It starts with the selection of sensors:

- Computer vision: The drone uses one or two cameras to see its surroundings. For depth perception, two cameras are required – just as humans need two eyes. Leutenegger uses two sensors and compares the images in order to gain a sense of depth. There are also depth cameras that generate 3D images directly.
- Inertial sensors: These sensors measure acceleration and angular velocity to detect the motion of bodies in space.

“Visual and inertial sensors complement one another very well,” says Leutenegger. That is because merging their data yields a highly precise image of a drone’s movements and its static surroundings. This enables the entire system to assess its own position in space. This is necessary for such applications as the autonomous deployment of robots. It also permits detailed, high-resolution mapping of the robot’s static surroundings – an essential requirement for avoiding obstacles. Initially, mathematical and probabilistic models are used without artificial intelligence. Leutenegger calls this the lowest level of “Spatial AI” – an area where he conducted research at Imperial College in London before coming to TUM.

## Spatial AI, step 2: Neural networks for understanding surroundings

Artificial intelligence in the form of neural networks plays an important role in the semantic mapping of the area. This involves a deeper understanding of the robot’s surroundings. By means of deep learning, the information categories that are comprehensible to humans and clearly visible on the image can be captured and digitally mapped. To do this, neural networks use image recognition based on 2D images to represent them in a 3D map. The resources needed for deep learning

recognition depend on how many details need to be captured to perform a specific task. Distinguishing a tree from the sky is easier than precisely identifying a tree or determining its state of health. For this kind of specialized image recognition, there is often not enough data for neural networks to learn from. For that reason, one goal of Leutenegger’s research is to develop machine learning methods that can make efficient use of sparse training data and allow robots to learn continually while in operation. In a more advanced form of spatial AI, the aim will be to recognize objects or parts of objects even when they are in motion.

## Current AI projects of the MIRMI professor: forest mapping, inspecting ships, construction robotics

Spatial artificial intelligence is already being applied in three research projects:

- Building walls: In construction robotics a robot equipped with grabbers (manipulators) is used. Its task in the SPAICR project, with four years of funding by the Georg Nemetschek Institute, is to build and dismantle structures such as walls. The special challenge in the project, in which Prof. Leutenegger is collaborating with Prof. Kathrin Dörfler (TUM professor of digital fabrication), is to enable robots to work without motion tracking, in other words with no external infrastructure. In contrast to past research projects, which used a clearly marked space in a lab with orientation points, the goal is for the robot to operate with precision on any building site.
- Digitizing the forest: In the EU project Digiforest, the University of Bonn, the University of Oxford, ETH Zürich, the Norwegian University of Science and Technology and TUM are working to develop “digital technology for sustainable forestry”. For that purpose, the forest needs to be mapped. Where is which tree located? How healthy is it? Are there diseases? Where does the forest need to be thinned out and where is new planting needed? “The research will provide the forester with additional information for making decisions,” explains Prof. Leutenegger. TUM’s task: Prof. Leutenegger’s AI drones will fly autonomously through the forest and map it. They will have to find their way around the trees despite wind and small branches to produce a complete map of the wooded area.
- Inspecting ships: In the EU project AUTOASSESS, the goal is to send drones into the interior of tankers and freighters to inspect the inside walls. They will be equipped with ultrasound sensors, among other instruments, to detect cracks. For this task the drones will need to be capable of flying autonomously in enclosed spaces with poor radio connectivity. In this application, too, motion tracking is not possible.

## Spatial AI creates basis for decisions

“We’re working to provide people in a wide range of fields with sufficient quantities of data to reach informed decisions,” says Prof. Leutenegger. He adds, however: “Our robots are complementary. They enhance the capabilities of humans and will relieve them of hazardous and repetitive tasks.” [www.tum.de](http://www.tum.de)

## Singapore pledges S\$10 million to the ITU P2C Digital Coalition

Recognising the importance of ensuring that all countries are able to participate in and benefit from the growth of the global digital economy, Singapore is pledging S\$10 million to the International Telecommunication Union (ITU) Partner2Connect (P2C) Digital Coalition to support the international community in harnessing the full potential of digital technologies in line with the United Nation's (UN) Sustainable Development Goals.

ITU, the UN specialised agency for Information and Communication Technologies, launched the P2C Digital Coalition in September 2021 to foster meaningful connectivity and digital transformation globally. This multi-stakeholder alliance promotes a partnership-based approach to mobilise the resources needed to achieve universal connectivity by 2030. ITU P2C has received over 700 pledges from government and private entities amounting to over US\$30 billion to date, but more can still be done to spur global digitalisation. [www.imda.gov.sg](http://www.imda.gov.sg)

## Geospatial Commission recommends creation of new taskforce for land use

A new Land Use Analysis Taskforce should be established to support decisions about how land in the UK is used, according to a new report from the Geospatial Commission

The report recommends that government policies related to using land should be supported by a new taskforce and cutting edge data analysis. It would assess the potential to reconcile competing demands for how we use our land to meet national priorities - such as those relating to infrastructure, housing, agriculture and the environment - with the land available in the UK.

The report sets out how better data can be used to drive land-use

decisions that drive growth, while also protecting the environment, adapting to climate change and achieving net zero emissions. [www.gov.uk](http://www.gov.uk)

## Satellite derived bathymetry for 13 Regions to NGA

TCarta Marine has been awarded a contract to deliver satellite derived bathymetry (SDB) and seafloor classification data for the coastal zones of 13 regions around the world to the National Geospatial-Intelligence Agency (NGA) under contract to Maxar Technologies.

TCarta will deliver seabed depth and feature maps from high-resolution multispectral Maxar WorldView-2 and WorldView-3 satellite imagery for the 13 regions. SDB measurements are accurate to depths of 20-30 meters depending on water conditions, with two-meter spatial resolution. Feature classification includes coral reefs, large rocks, sandbars, and other navigation hazards. [www.tcarta.com](http://www.tcarta.com)

## Underwater mapping breakthrough

Aurigo Software is partnering with the University of Florida's Department of Mechanical and Aerospace Engineering to develop an innovative system for underwater surveying, mapping and inspection, provisionally named Bathydrone.

The current process to gather data for new underwater construction or the inspection of existing assets such as bridges, docks and levees consists of manual surveying from divers or survey sensors mounted to a boat. With the new, safer and more efficient Bathydrone system, a drone drags a small vessel on the water's surface, eliminating the need for manual surveying. The vessel is equipped with a COTS sonar unit mounted on its bottom. The sonar unit has down-scan, sidescan and chirp capabilities and logs data onboard the console, which is located inside the hull. Data can then be retrieved post-mission from the console and plotted in various ways. [www.aurigo.com](http://www.aurigo.com)

## Safran's White Rabbit outperforms alternative PNT industry requirements

White Rabbit, an essential solution in Safran's Navigation & Timing portfolio for critical infrastructure, recently received high praise in a landmark report from the European Commission (EC) Joint Research Center (JRC) to evaluate the effectiveness of Alternative Positioning, Navigation and Timing platforms.

For more than eight months, the commission studied a variety of available solutions to assess the performance of Alternative-PNT demonstration platforms in a variety of situations where there is signal loss and a backup system is necessary. The selected solutions were evaluated for precise and robust timing and positioning services in challenging indoor and outdoor environments. Time transfer technologies over different means, including fiber, wired channels, etc.

Safran's White Rabbit is a high-accuracy time and frequency distribution protocol, which combines Precise Time Protocol (PTP) packets with the frequency base of Synchronous Ethernet (SyncE) to provide sub-nanosecond time transfer accuracy over an optical fiber. While the results of the test campaign showed that all Alternative-PNT platforms under evaluation demonstrated performances in compliance with the requirements set, White Rabbit excelled in its performance. Safran demonstrated not only White Rabbit's ultra-accurate time transfer over fiber optics but also its high-performance time generation, resiliency (based on failover and holdover), interoperability, and user-friendly monitoring capabilities. <https://publications.jrc.ec.europa.eu>

## Galileo second generation enters full development phase

On May 31, the European Space Agency (ESA) announced the main procurement batch of Galileo Second Generation (G2), initiated in summer 2022, has been finalized. The system is now ready for its on-orbit validation development phase.


Satellite-building contracts were awarded in May 2021 to Thales Alenia Space and Airbus Defence and Space to create two independent families of satellites amounting to 12 G2 satellites in total. Separate contracts were also awarded to Safran Electronics and Defence-Navigation and Timing and Leonardo to provide the ultra-precise atomic clocks carried aboard.

Employing electric propulsion for the first time, and hosting a higher-strength navigation antenna, the G2 satellites will incorporate six (rather than four) enhanced atomic clocks as well as inter-satellite links to communicate and cross-check with one another. They will be controllable with an increased data rate to and from the ground and will operate for 15 years on orbit.

In addition, G2's fully digital payloads are being designed to be easily reconfigured on orbit, enabling them to respond to the evolving needs of users with novel signals and services. [www.esa.int](http://www.esa.int)

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### New Galileo sensor station operating in South Pacific

The newest addition to the network of Galileo sensor stations (GSS) is up and running in Wallis and Futuna, a French territory in the South Pacific. It enables increased Galileo coverage in the southern hemisphere. The European Union Agency for the Space Programme (EUSPA) reported that the decision for the new station was made in June 2020; however, due to COVID-19, its deployment did not begin until summer 2022. In October 2022, the second mission to Wallis and Futuna took place to complete the deployment and connect the station to the ground mission segment network for data collection. The GSS is a network of antennas deployed at remote locations around the world. They have small, omnidirectional receiving antennas 50 cm high that check the accuracy and signal quality of individual satellites and pinpoint current satellite orbits. Establishing GSS is difficult and requires security accreditation by EUSPA's Security Accreditation Board. To make the best use of the Galileo services, users rely on more than just the satellites. [www.euspa.europa.eu](http://www.euspa.europa.eu) 

## EUSPA EO and GNSS Market Report

This first issue of the EO and GNSS Market Report provides insights into how EO and GNSS contribute to a plethora of applications across a total of 17 market segments, followed by an additional Editor's Special focus on Innovative Solutions for Health.

Facing global challenges such as the digital revolution, climate change and pandemics threatening the economy at a worldwide scale, society – more than ever – relies on innovative solutions to deal with the big data paradigm, respond to and mitigate natural and man-made disasters, curb the spread of deadly diseases and strengthen a global supply chain that underpins our daily lives. EO and GNSS will play a vital role in contributing to these innovative solutions through dozens of applications that are emerging or already in use by citizens, governments, international organisations, NGOs, industry, academia and researchers around the world. Between 2021 and 2031, annual shipments of GNSS receivers are forecasted to grow from 1.8 billion units to 2.5 billion units. These shipments will be heavily dominated by the Consumer Solutions, Tourism and Health segment following the wave of global smartphone and wearable sales that contribute to roughly 92% of global shipments.


Consequently, the global installed base of GNSS devices in use is expected to reach over 10 billion units by 2031. Here again a dominant role is set aside for the mass market segments of Consumer Solutions, Tourism and Health and Road and Automotive, which will contribute the lion's share of 98% of all devices in use. The global GNSS downstream market revenues, covering both device sales and service-related revenues, is expected to grow at a CAGR of 9.2% over the next decade, reaching a total

of €492 billion by 2031. Over 82% of these revenues will be generated by value-added services (i.e. €405 billion in 2031). Besides the dominance of the aforementioned mass market segments, the professional markets of (i) Agriculture, (ii) Urban Development and Cultural Heritage, and (iii) Infrastructure will be the main contributors to the global GNSS revenue stream.

In terms of demand, the Asia-Pacific region continues to dominate the GNSS revenues market both for device and services revenues (i.e. 36% and 40% of the global share respectively in 2021). Whilst the region is expected to increase its share of the global services revenues, nearing 46% by 2031, Asia-Pacific will see a decline of its market share of device revenues (expected to drop to 28%). In this area, the region will be challenged by the upcoming markets of South America & Caribbean, Non-EU27 Europe and the Middle East & Africa regions.

With revenues set to double from roughly €2.8 billion to over €5.5 billion over the next decade, the market for Earth Observation applications is boosted by a large pool of value-added services (i.e. 85% of global revenue). These contribute across all segments, though especially in those of Climate Services, Urban Development and Cultural Heritage, Agriculture, Energy and Raw Materials and the Insurance and Finance segment. When it comes to the sale of EO data (worth €0.8 billion in 2031, 15% of global revenue), the top five of segments is made up of Urban Development and Cultural heritage, Agriculture, Insurance and Finance, Energy and Raw Materials as well as Consumer Solutions, Tourism and Health.

Despite a relatively small market share in 2021 (i.e. 5% or €145 million), the Insurance and Finance segment – boosted by the growing use of parametric insurance products in the context of disaster resilience frameworks by commercial entities in areas with high exposure to extreme events—will increase its uptake of EO data and value-added services over the decade, pushing the Insurance and Finance segment to a forecasted €1 billion EO-enabled revenues by 2031 (constituting an 18% market share). From a supply perspective, the EO market is jointly led by the United States of America and Europe with market shares of 42% and 41% respectively. Europe plays a leading role in the market of Analysis, Insights and Decision Support (the subset of value-added services closest to end- users) with a 50% market share covering all segments, contributing to its overall market share above. Although challenged by US companies in the mature Agriculture market and the growing Insurance and Finance segment, European companies lead the market across almost all other segments, excluding the Emergency Management and Humanitarian Aid segment (led by Asian companies with 52%) and the niche EO market of Road and Automotive (led by US companies with 77%).

Based on the latest European Association of Remote Sensing Companies (EARSC) Industry Survey, SMEs and start-ups account for more than 93% of European EO companies, showcasing the importance of small companies for the European EO economy. As presented throughout this report, the flagship EU Space Programme – driven in tandem by Galileo and EGNOS on one side and Copernicus on the other – has become a major enabler in the downstream space application market. [www.euspa.europa.eu](http://www.euspa.europa.eu) 

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### OSK successfully launches third GHOS<sup>t</sup> satellite

Orbital Sidekick (OSK successfully launched GHOS<sup>t</sup> 3, the third satellite in its planned GHOS<sup>t</sup>(™) (Global Hyperspectral Observation Satellite) constellation aboard the Transporter 8 rideshare mission. This launch marks the halfway point for deployment of the company’s planned six-satellite constellation. OSK is on track to deploy two more satellites this year aboard the Transporter 9 rideshare mission and by early next year, it will consist of six equivalent, fully operational microsats, each featuring a proprietary hyperspectral imager unique to OSK. With three GHOS<sup>t</sup> satellites in orbit, OSK’s capabilities for delivering enhanced monitoring and intelligence services for its customers are further enhanced. [www.orbitalsidekick.com](http://www.orbitalsidekick.com)

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### LiDAR perimeter intrusion detection

Quanergy Solutions announced a partnership with Convergent. Together, the two companies will deliver enhanced perimeter intrusion detection capabilities for the utilities industry.

Convergent is collaborating with Quanergy to design, engineer, and implement various security solutions to provide early detection with hyper accuracy and faster response times. Convergent’s offerings enable the convergence of physical security, IT, IoT, and an ecosystem of API software to create operational efficiencies through automation.

Convergent will harness the potential of LiDAR technology in its solutions by integrating Quanergy’s offerings. [quanergy.com](http://quanergy.com)

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### Agrograph and Planet Labs PBC partnership

Agrograph’s new partnership with Planet Labs PBC to integrate Planet high-resolution global satellite data with Agrograph’s expert geospatial data technology to comprehensively support clients’ need for data-driven

business and farm-risk management decisioning tools. The partnership aims to benefit finance, insurance and agri-business service providers, government entities, and other organizations seeking to measure financial and environmental risk, identify business opportunities, and inform cropland agriculture capital investment strategy across the globe. [www.planet.com](http://www.planet.com)

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### Planet partners with the UAE Space Agency

Planet Labs announced its partnership with the United Arab Emirates (UAE) Space Agency, to build a regional satellite data-driven loss and damage atlas for climate change resilience. The initiative aims to provide data to a select country facing high degrees of climate risk to help build resilience, make informed policy decisions, and stimulate financial programs for climate adaptation and mitigation. [www.planet.com](http://www.planet.com)

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### BIRD Aerosystems unveils maritime pollution detection solution

BIRD Aerosystems launched its new ASIO solution, the ASIO Environmental Monitoring System.

In response to the critical challenge of maritime pollution detection and the imperative to prevent costly and ecologically devastating oil spills, it introduces this new innovative solution, based on the company’s renowned ASIO task force. The ASIO Environmental Monitoring System Integrates Electro-Optical Payload and Multi-Mode Radars with a new advanced sensor named SEA EYE.

The SEA EYE enables real-time spectral detection and classification of surface and even submerged oil and organics. Installed on the ASIO airborne platform, it offers real-time oil pattern recognition and classification, accurately predicting the oil’s spread. Its prediction tool also empowers users to anticipate the oil’s spread, enabling swift and efficient

responses to minimize their impact on the environment and the economy and mitigate potentially catastrophic consequences. [www.birdaero.com](http://www.birdaero.com)

### EUSI and Airbus partnership

The European Maritime Safety Agency (EMSA) has awarded European Space Imaging (EUSI) and Airbus a 24-month contract for the delivery of Very High Resolution (VHR) optical satellite imagery.

EMSA relies on optical satellite images as part of its maritime surveillance services to the European Commission and Member States to support a number of functions in the maritime domain such as safety, security, environmental monitoring, and law enforcement. The current framework awarded to EUSI and Airbus will have the possibility to be renewed for two additional periods of 12 months each.

Airbus will be supplying imagery collected by SPOT, Pléiades and Pléiades Neo satellites, whilst EUSI will be supplying imagery from the current Maxar satellite constellation, the new Maxar WorldView Legion satellites once on orbit, as well as other value-added services. Leveraging the satellites' respective ground stations, the data will be delivered in near real-time to EMSA, enabling fast response times and critical insights to decision-makers. [www.intelligence-airbusds.com](http://www.intelligence-airbusds.com)

### Australia collaborates on international effort to launch COSPAR satellite

Australian space startup HEX20 is collaborating with international partners to launch the COSPAR satellite. The joint effort is coordinated by the Committee on Space Research (COSPAR), an international scientific body, with the participation of space research institutions LASP (USA), NCU CAPE (Taiwan),

LATMOS (France), and SKYROOT Aerospace (India). The project will study the Earth's atmosphere, including atmospheric dynamics and chemistry, and the effects of space weather. It will provide valuable data for weather forecasting, climate modeling and scientific exploration. [www.globalaustralia.gov.au](http://www.globalaustralia.gov.au)

### Pix4D unveils new open standard for photogrammetric data

Pix4D has introduced OPF, a new standard for exchanging photogrammetry projects. OPF is a fully open and free specification, enabling the storage and exchange of photogrammetric data among different parties and software products, even if they are developed by different companies. At its core, it is a flexible and extensible format that stores all the data related to a reconstructed 3D model created through photogrammetry. This includes information on both the inputs and outputs of the photogrammetry process.

## ISRO launches next-gen NVS-1 NavIC satellite

The Indian Space Research Organisation (ISRO) successfully launched the second-generation Geosynchronous Satellite Launch Vehicle (GSLV) from the second launch pad at the Satish Dhawan Space Centre (SHAR), about 130 km from Chennai on 29th May.

The powerful GSLV rocket which had three stages, stood tall at a height of 51.7 meters and weighed a staggering 420 tons. At 10.42 a.m., it took off into the sky, successfully escaping the strong pull of Earth's gravity. The positioning of NavIC signals are intended to be better than 20 meters and timing accuracy is intended to be 50 nanoseconds. The primary mission of the 51.7-meter-tall Geosynchronous Satellite Launch Vehicle is to deploy the navigation satellite NVS-01 weighing 2,232 kg.

The NVS-01 carries navigation payloads L1, L5 and S groups and in correlation with the past one, the second-generation satellite would likewise convey an indigenously created rubidium atomic clock. The satellite with a mission life of 12 years is powered by two solar arrays and lithium-ion batteries capable of generating up to 2.4 kW of power during eclipse. The NVS series of satellites will maintain and enhance NAVIC with advanced features. [www.isro.gov.in](http://www.isro.gov.in)



### Airwayz Partnership with FlightOps

Airwayz announces a partnership with FlightOps. The integration between both the companies will allow drone operators to automate drone management and will be used for the first time during the second phase of the Israel National Drone Initiative (INDI2). This collaboration marks a significant step forward towards commercially viable U-Spaces. With advanced, automated drone management, a secure and reliable environment is ensured for drone operations. <https://airwayz.co>

### Percepto raises \$67M Series C

Percepto announced has a combined \$67M Series C in equity and debt funding, led by Koch Disruptive Technologies (KDT), alongside new investors Zimmer Partners and one of the largest U.S. energy companies. The round includes participation from existing investors U.S. Venture Partners, Delek US Holdings, Atento Capital, Spider Capital and Arkin Holdings, bringing the total investment in the company to more than \$120 million.

Percepto recently received an unprecedented, nationwide Beyond Line of Sight (BVLOS) waiver from the FAA, allowing the company to provide any US critical infrastructure site with remotely-operated automated drones without the need for site specific approvals from the FAA. [www.percepto.co](http://www.percepto.co)

### Draganfly expands collaboration with DSNS Emergency Services Ukraine

Draganfly Inc. announced the successful completion of critical training and demonstrations conducted in Ukraine. The training program involved Draganfly's innovative Situational Assessment UAV technology, which was used to train personnel from the Main Department of the State of Emergency Services Cherkasy Region Ukraine, including the fire brigade and demining units.

The training provided to DSNS state emergency services personnel included the fire brigade, demining units, and local

Rotary officials. This comprehensive training approach aims to equip participants with the necessary expertise to leverage Draganfly's turnkey demining solution. [www.draganfly.com](http://www.draganfly.com)

### NAeL and Garuda Aerospace, India sign MoU for Drones Manufacturing

Naini Aerospace Engineering Limited (NAeL) and Garuda Aerospace (GA) signed a Memorandum of Understanding (MoU) for the manufacturing of drones to contribute towards developing the farm sector.

The NAeL owned by a subsidiary of Hindustan Aeronautics Limited under the control of Manufacturing of Defense would be manufacturing drones with a payload of 25 kilograms, which would be also used by the farm community. The modified drone manufacturing will lead to ease the farm work.

### VERSES expands autonomous drone governance infrastructure

VERSES AI Inc. a cognitive computing company specializing in the next generation of artificial intelligence, recently announced the successful completion of its Urban Air Mobility (UAM) demonstrations in Milan, Italy.

As part of Flying Forward 2020 (FF2020), a European Commission-funded special research and innovation project developing Urban Air Mobility infrastructure, and in collaboration with the Center for Advanced Technologies in Health and Well-being of the San Raffaele Hospital

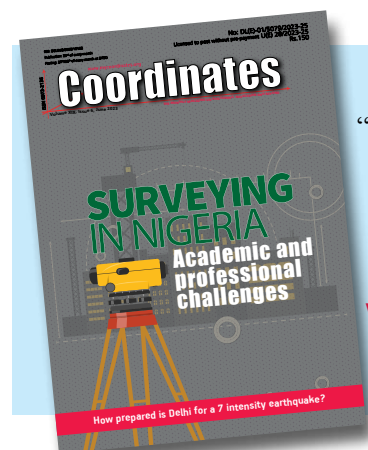
(OSR) which is the technological research unit that coordinates the activities of the FF2020 living lab in Milan, VERSES successfully deployed multiple autonomous drones to deliver medicines in the campus and monitor their perimeter against intruders. [verses.io](http://verses.io)

### Parallel Flight Technologies inks with India's UAV Systems

Parallel Flight Technologies has announced a purchase agreement for 50 aircraft, with paid deposits, from UAV Systems Private Limited (UAVS), a drone and robotics solution provider based in India. In addition, Parallel Flight will provide ongoing maintenance, repair and overhaul support to UAV Systems and its end-user base for increased efficiency and uptime of all platforms. [www.parallelflight.com](http://www.parallelflight.com)

### New software enables AI-powered bathymetric data processing

GeoAcoustics has released GS4 software v1.0.25 for GeoSwath bathymetric sonars, adding several upgrades including an artificial intelligence data processing system developed in collaboration with the University of East Anglia. It augments the existing automated filtering in the GS4 software by removing surplus and undesired data autonomously; during acquisition, the system is designed to log clean data, without any user intervention in the cleaning process, enabling better operational agility and decision support while cutting the time to final data in post-processing. [www.geoacoustics.com](http://www.geoacoustics.com)



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[www.mycoordinates.org](http://www.mycoordinates.org)

**Baidu launches \$145 mn fund to back Chinese AI startups**

Baidu Inc., China has announced that it will set up a venture capital fund of 1 billion yuan (\$145 million) to back Chinese startups that are focused on generative AI, startups like the ChatGPT.

Baidu will use the fund to incubate projects and will launch a competition to develop applications built atop its ERNIE large language model (LLM) or integrate the model into their existing products, it said. [www.reuters.com](http://www.reuters.com)

**Run:ai and AI Singapore partnership**

Run:ai, has been chosen as a strategic partner by AI Singapore, a national R&D programme launched by the National Research Foundation, Singapore, which is focused on anchoring deep national capabilities in AI. This collaboration aims to deliver scalable infrastructure solutions for a wide range of AI projects and help AI Singapore in its mission to accelerate the adoption of AI by the industry.

As the national AI programme, AI Singapore plays a central role in helping organizations adopt AI solutions. Through their flagship 100 Experiments Programme (100E) coupled with the award-winning AI Apprenticeship Programme (AIAP), they have worked with more than 60 companies and trained more than 200 Singaporean AI engineers to develop, test and deploy hundreds of AI models that address real world problems. Given the ever-changing nature of AI workloads and the scale at which AISG’s programmes operate, distributing compute resources, including GPUs across on-premise and cloud infrastructures effectively between the various projects is a significant challenge. [www.run.ai](http://www.run.ai)

**DMV issues an autonomous vehicle deployment permit to Mercedes-Benz**

The California Department of Motor Vehicles (DMV) has issued an autonomous vehicle deployment permit

to Mercedes-Benz USA, LLC, allowing the company to offer its DRIVE PILOT automated driving system on designated California highways under certain conditions without the active control of a human driver. Mercedes-Benz is the fourth company to receive an autonomous vehicle deployment permit in California and the first authorized to sell or lease vehicles with an automated driving system to the public. [www.dmv.ca.gov](http://www.dmv.ca.gov)

**Marelli and IAC announce technological partnership**

Marelli has announced that it will be the exclusive race control technology sponsor of the Indy Autonomous Challenge(IAC). A technical partnership for connectivity solutions has been signed, based on which Marelli will supply, to all IAC fully autonomous racecars, technologies to ensure vehicle connection, race control, and data analysis and will also provide technical support.

The IAC is a series of competitions among full-scale autonomous racecars, driven by software programmed by top engineering and technology university teams from around the world, that compete on iconic tracks. A primary goal of the IAC is to advance technology for fully autonomous vehicles and advanced driver-assistance systems (ADAS). [www.marelli.com](http://www.marelli.com)

**TuSimple among first to receive fully driverless test license in China**

TuSimple Holdings, Inc. has announced it has been awarded a fully driverless test license by the Pudong New Area of Shanghai in China. It is among the first batch of companies to be awarded, thus enabling the Company to conduct SAE Level 4 fully autonomous Driver Out testing in the designated test areas of Yangshan Deep-water Port and Donghai Bridge. Shanghai is also set to become the first city in China to pass legislation to allow Level 4 fully driverless testing of autonomous trucks. [www.tusimple.com](http://www.tusimple.com)

**Tracking Xona PULSAR LEO signal generated by Spirent simulator**

NovAtel announced a successful test demonstrating of their OEM7 GNSS receivers track Xona Space Systems PULSAR signals generated by a Spirent Communications simulator. This test shows that NovAtel GNSS receivers can track a Spirent simulated L-band signal identical to the PULSAR signal broadcast by Xona’s low Earth orbit (LEO) satellites. The Xona LEO signals will complement GNSS, improving resiliency, security and precision for positioning, navigation and timing (PNT). [www.spirent.com](http://www.spirent.com)

**Tallysman, u-blox partnership**

Tallysman Wireless and u-blox have partnered to develop PointPerfect precise point positioning real-time kinematic augmented smart antennas. The ZED-F9R high precision GNSS and the NEO-D9S L-band receivers from u-blox have been integrated with Tallysman’s technology. The product integration will provide accuracy and precision. [www.tallysman.com](http://www.tallysman.com)

**New maritime navigation sensor Northrop Grumman**

The U.S. Navy awarded Northrop Grumman Corporation a production contract for the new AN/WSN-12 Inertial Sensor Module (ISM). The AN/WSN-12 ISM is a next-generation sensor that significantly improves maritime navigation in GPS denied environments for surface ships and submarines. The new AN/WSN-12 ISM is a key component of the U.S. Navy’s AN/WSN-12 Inertial Navigator System (INS), upgrading the Northrop Grumman built AN/WSN-7 INS. [www.northropgrumman.com](http://www.northropgrumman.com)

**Carlson Software releases multi-application tablet and GNSS solution**

Carlson Software has released the RT5 rugged tablet data collector and the RTk5GNSS solution, which integrates the form factor of the RT5 with real-time kinematic GNSS performance. The Carlson RT5 is designed for surveying,



stake-outs, construction layout and GIS mapping, and is bundled with Carlson SurvPC — the Windows-based data collection program. The RT5 can run SurvPC with Esri OEM for use in the field. [www.carlsonsw.com](http://www.carlsonsw.com)

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### **CHC Navigation's Hybrid GNSS+INS Sensor**

The CGI-610 GNSS/INS sensor is an advanced dual-antenna receiver designed for reliable and accurate navigation and positioning in challenging terrestrial, marine or airborne applications. Designed to meet the needs of 3D positioning and autonomous vehicle guidance applications, it provides high performance in urban canyons and other harsh environments where GNSS signals are lost or degraded. Incorporating GNSS technology and an industrial-grade inertial measurement unit, the sensor delivers accurate hybrid position, attitude and velocity data up to 100 Hz, driven by CHC Navigation algorithms. [chcnv.com](http://chcnv.com)

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### **RIEGL partners with Diamond Aircraft**

RIEGL has partnered with Diamond Aircraft Austria since the inception of its Special Mission Aircraft business. It has recently acquired a new test and calibration aircraft, the DA62 SurveyStar.

After successfully operating one of the very first DA42 GeoStar aircraft for nearly 15 years, RIEGL is now the first Austrian operator to embrace its groundbreaking successor, the DA62 SurveyStar. This achievement highlights the strong collaboration between RIEGL and Diamond Aircraft. [www.riegl.com](http://www.riegl.com)

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### **Adtran expands Oscilloquartz PNT platform**

Adtran recently added new features to its Oscilloquartz aPNT+ technology suite to better protect critical timing networks. The upgrades include enhancements to the core, edge and access synchronization solutions, adding more protection against GNSS vulnerabilities and cyberattacks for

those who operate telecommunications, financial networks, power grids and defense infrastructure, according to a news release. The timing technology leverages more sources of reliable timing and offers new capabilities that detect disturbances and assure vital PNT services. [www.adtran.com](http://www.adtran.com)

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### **Collins Aerospace business selected for air traffic management projects**

Raytheon Technologies' Collins Aerospace business has been selected to participate in eight projects under the European Union's SESAR 3 Joint Undertaking (SESAR 3 JU). A collaboration between European private and public partners, the SESAR 3 JU aims to accelerate the delivery of the Digital European Sky through the development of new technologies to manage conventional aircraft, drones, air taxis and vehicles flying at higher altitudes.

As part of the initiative, Collins will work with the air traffic management value chain, including air navigation service providers, airlines, aircraft OEMs, system providers and academia to help create new innovations in key technology focus areas such as connectivity, U-space, trajectory-based operations, airport solutions, autonomy and data services. It will lead the JARVIS (Just A Rather Very Intelligent System) project that will leverage artificial intelligence-based technologies to increase automation in the flight deck and control tower operations as a way to reduce pilot and operator workload while enhancing safety and security. [collins.com](http://collins.com)

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### **Infleqtion unveils the future of resilient navigation**

Infleqtion has announced breakthrough progress in advancing the field of quantum navigation by a University Colorado team in work supported by Infleqtion and the National Science Foundation. The team demonstrated the world's first software-configured, quantum-enabled high-performance accelerometer by combining machine learning with quantum sensing. It is designed for Positioning, Navigation, and Timing

(PNT) applications that operate under accelerations up to several tens of times the Earth's gravity (g). The accelerometer demonstrated a sensor volume reduction of greater than a factor of 10,000 times compared to the current state-of-the-art technology. [www.infleqtion.com](http://www.infleqtion.com)

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### **PredictING disaster and traffic safety management**

Hexagon's Safety, Infrastructure & Geospatial division and Fujitsu Limited have announced the joint development of digital twin applications for predicting and mitigating natural disasters and traffic accidents.

The two companies are developing a prediction model that calculates the extent and impact of flooding from precipitation data, visualizes the extent of flooding and performs damage prediction analysis. Based on the analysis, cities can develop disaster response plans. [hexagon.com](http://hexagon.com)

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### **Spirent announces SimXona, a Xona Satellite constellation simulator**

Spirent Communications has announced SimXona, an industry-first Xona satellite constellation simulator, fully certified by Xona Space Systems.

Xona is developing PULSAR, a commercial positioning, navigation, and timing (PNT) service built on a backbone of low Earth orbit (LEO) small satellites. Xona's patented high-powered smallsat signals will improve PNT resilience and accuracy by augmenting GNSS. [www.spirent.com](http://www.spirent.com)

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### **NextNav's Pinnacle to provide Precision Z-Axis capabilities for 911 calls**

NextNav, a leader in next generation GPS, has been selected by a nationwide U.S. carrier to deliver vertical location capabilities for Enhanced 911 via its Pinnacle service. It will enable precise z-axis data – which is increasingly critical for emergency service operations – for 911 calls made on the carrier's

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### July 2023

**Esri User Conference**  
10-14 July, 2023  
San Diego, CA, USA  
[www.esri.com](http://www.esri.com)

**IUGG 2023**  
11-20 July  
Berlin, Germany  
[www.iugg2023berlin.org](http://www.iugg2023berlin.org)

**Surveying and Geomatics Educators' Society (SaGES) 28th biennial conference**  
16-20 July  
University of Calgary, Canada  
<https://wpsites.ucalgary.ca/sages2023>

**IGAARS 2023**  
16 - 21 July  
Pasadena, CA, USA  
<https://2023.ieeeigars.org>

**Drone International Expo 2023**  
26 - 27 July  
Delhi, India  
<https://droneinternationalexpo.com>

### August 2023

**International Cartographic Conference 2023**  
13 - 18 August  
Cape Town, South Africa  
<https://icaci.org>

### September 2023

**Commercial UAV Expo**  
5-7, September 2023  
Las Vegas, USA  
[www.expouav.com](http://www.expouav.com)

**ION GNSS+ 2023**  
11-15 September  
Denver, Colorado, USA  
[www.ion.org](http://www.ion.org)

**European Lidar Conference (ELC)**  
13 - 15 September  
Cluj-Napoca, Romania  
<https://enviro.ubbcluj.ro>

### October 2023

**Asian Conference on Remote Sensing (ACRS 2023)**  
30 October to 3 November  
Taipei, Taiwan  
<https://acrs2023.tw>

**Intergeo 2023**  
10-12 October  
Berlin, Germany  
[www.intergeo.de](http://www.intergeo.de)

### November 2023

**Trimble Dimensions 2023**  
6-8 November  
Las Vegas, USA  
[www.trimble.com](http://www.trimble.com)

**18th International Conference on Location Based Services (LBS 2023)**  
20-22 November  
Ghent, Belgium  
<https://lbs2023.lbsconference.org>

entire device portfolio, expanding the availability of life-saving technology across the US and meeting FCC z-axis / E911 requirements. <https://nextnav.com>

## BAE Systems unveils NavGuide™ GPS receiver

BAE Systems has unveiled NavGuide™, a next-generation Assured-Positioning, Navigation and Timing (A-PNT) device featuring M-Code GPS technology. It is a field-installable replacement to the Defense Advanced GPS Receiver (DAGR) designed for quick integration into current DAGR mounts and accessories without mission interruption. [www.baesystems.com](http://www.baesystems.com)

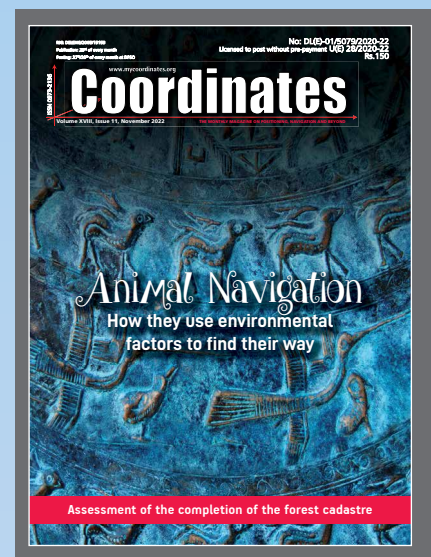
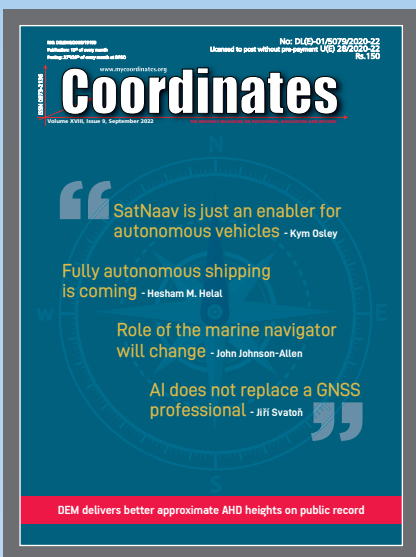
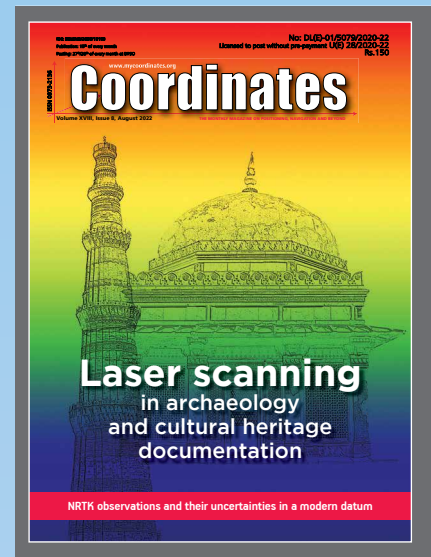
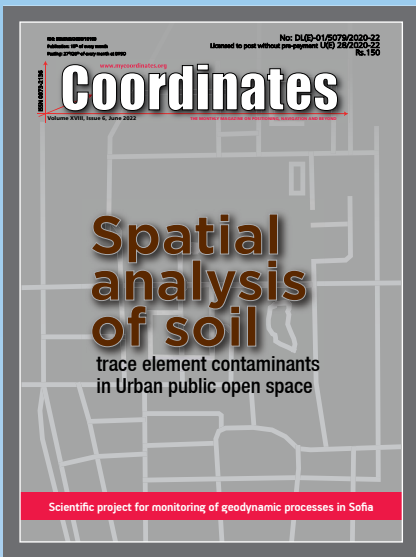
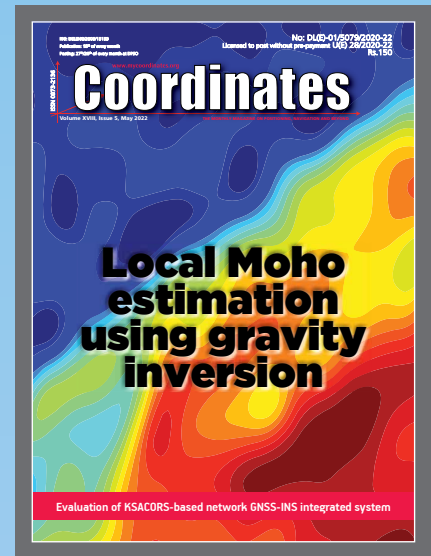
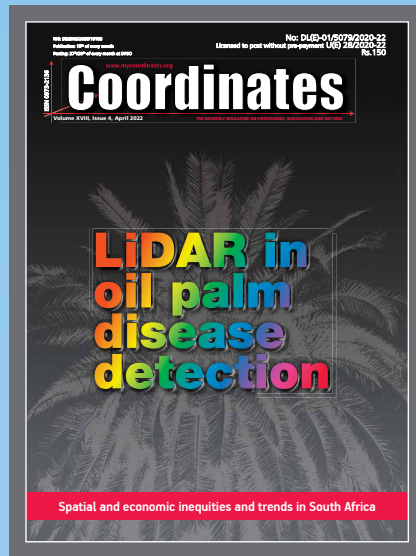
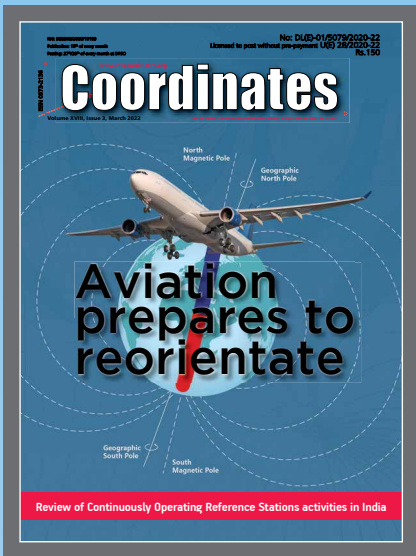
## The Ohio State University to Establish Trimble Technology Labs

Trimble announced that the Ohio State University will establish two state-of-the-art Trimble Technology Labs for the College of Food, Agricultural, and Environmental Sciences (CFAES). The multidisciplinary labs will enhance Ohio State's teaching, research, and outreach activities in food and agricultural engineering and construction management. The Labs will officially open during Autumn Semester 2023 and will provide students with access to Trimble technology solutions used by professionals in the agriculture, construction, and geospatial industries.

## SpacePNT completes integration testing of NaviLEO

SpacePNT and D-Orbit complete integration testing of SpacePNT's unique NaviLEO GNSS receiver technology onboard ION Orbital Transfer Vehicle (ION SCV011) that is scheduled to be launched from California Vandenberg Space Force Base this month of June 2023.

NaviLEO is a low-cost, high performance multi-GNSS multi-frequency receiver product platform that has been developed by SpacePNT in Switzerland to address the specific requirements of the New Space market, bridging the gap between today's low-end and high-end GNSS space receiver solutions. <https://spacepnt.com>



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