

## Studying and suggesting several contents to institutionalise the management of remote sensing activities in Vietnam based on the legal basis and practical requirements

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### **Abstract:**

**In Vietnam, achievements in research and application of remote sensing technology have significantly improved the efficiency of many socio-economic activities. Although the application and development of this technology are underway, numerous inadequacies have been revealed. The lack of a comprehensive remote sensing law in Vietnam to address and support socio-economic activities has become evident, leading to many difficulties in assessing the quality of remote sensing products of different agencies, making it challenging to develop remote sensing applications and services. Furthermore, remote sensing application agencies are mainly concentrated in central agencies, while remote sensing in localities has high practical significance and is essential to serve the state management of natural resources and the environment locally. In addition, there is no close coordination between local agencies and central agencies - the main reason for overlapping work contents, causing a waste of budget investment and, at the same time, leading to confusion and passivity in arranging annual plans and allocating expenditures for remote sensing. Thus, institutionalising the management of remote sensing activities based on legal and practical requirements in Vietnam is an urgent need. This includes the management of space and ground segments, commercialisation of remote sensing, international training and cooperation, and the creation of a legal corridor to promote remote sensing development, overcome policy gaps, and support the socio-economic life, national defence, security, and environmental monitoring.**

**Keywords: institutionalisation, laws, remote sensing activities, Vietnam.**

**Classification numbers: 4.2, 5.3**

### **1. Introduction**

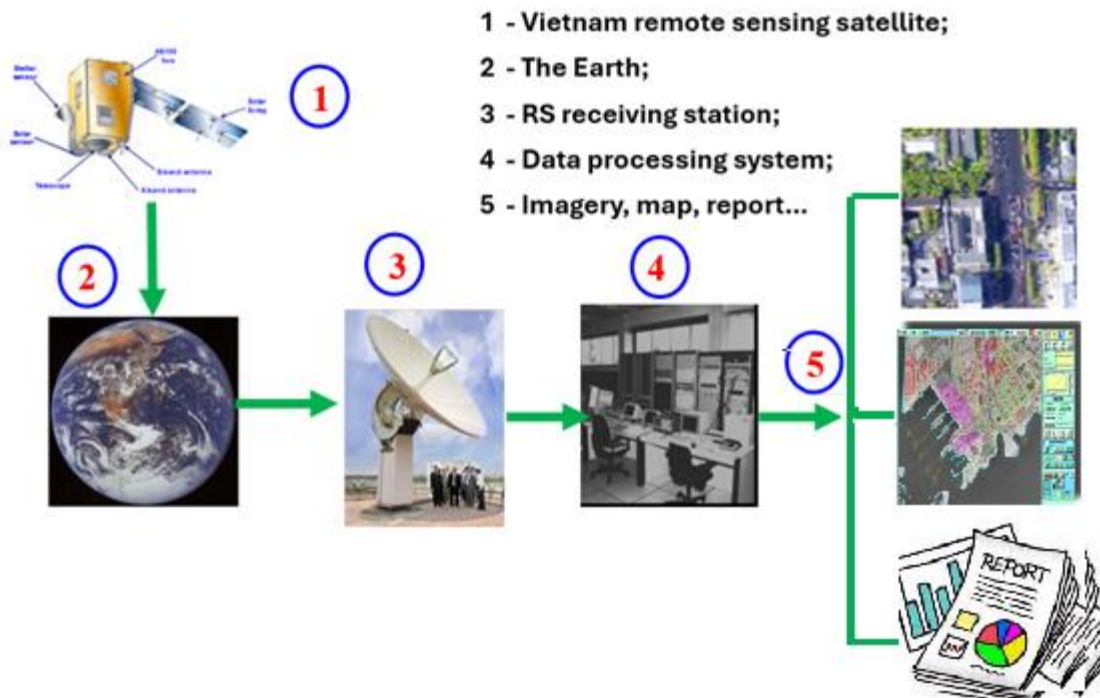
Due to the wide application in most scientific fields, remote sensing has received significant attention from developed countries, which have established comprehensive legal

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policies for its management. Since the Soviet Union successfully launched the first Sputnik satellite in 1957, rapid advancements in space law and remote sensing regulations have followed. Developed countries like the United States, Canada, Germany, the UK, and Japan have enacted Remote Sensing Laws and Remote Sensing Satellites Management Laws in recent decades.

These laws provide a legal basis for state management in remote sensing, enabling the unified management and implementation of its applications. They also stipulate the management functions of space components, including satellites, remote sensing sensors, and satellite orbits, as well as ground components like receiving stations, satellite control stations, and data processing facilities. Additionally, these laws regulate training, international cooperation, and commercial activities related to remote sensing [1-3]. In Vietnam, the state management of remote sensing was only officially implemented in 2019 with the government issuing Decree No. 03/2019/ND-CP, the most authoritative legal document in the field of remote sensing to date [4] (Fig. 1).



**Fig. 1. Illustration of remote sensing system in Vietnam.** Source: Vietnam remote sensing receiving station.

This Decree established a legal foundation for the unified state management of remote sensing activities, forming the basis for the current suite of legal documents on remote sensing. However, as implementation has progressed, the policies outlined in Decree No. 03/2019/ND-CP have gradually revealed several limitations and inadequacies, rendering them unsuitable for the country's current needs. This Decree is narrowly focused, only guiding the implementation of one chapter of the Law on Surveying and Mapping, whereas remote sensing in Vietnam is applied across multiple sectors and disciplines. Moreover, the Decree lacks

adequate provision for long-term and annual surveying and mapping plans across ministries, branches, and localities, leading to insufficient coordination with the Ministry of Natural Resources and Environment. This has resulted in overlapping and redundant measurements, causing budgetary wastage and contributing to confusion and passivity in the organisation of annual plans and the allocation of budgetary resources for measurement activities. This study aims to analyse and evaluate the management of remote sensing activities as institutionalised in laws and strategic directives in several countries globally, thereby proposing elements of remote sensing management that need to be institutionalised based on legal and practical requirements in Vietnam.

## **2. Law on remote sensing management in several countries in the world**

Globally, many developed countries have prioritised strategies and policies for managing remote sensing activities, supported by comprehensive laws. In 1984, the US government enacted the Land Remote-Sensing Commercialization Act [2], which was superseded in 1992 by The Land Remote Sensing Policy Act [3]. This legislation set out to (1) preserve the right to acquire and disseminate digital remote-sensing data, (2) ensure such data are available on a non-discriminatory basis, (3) commercialise space remote-sensing functions relating to private sector operations, and (4) maintain government-controlled remote-sensing functions that are essentially public services. Moreover, US remote sensing policy, through the "U.S. Space Priorities Framework" [5], aims to manage national satellite systems, particularly Landsat, to enhance the understanding of Earth, the universe, and humanity; support national security; create jobs and economic opportunities; and deliver essential space data, products, and services that drive innovation in the US and globally. The National Aeronautics and Space Administration (NASA) plays a crucial role in this framework, with a focus on strengthening remote sensing management and development to improve life on Earth and respond to climate change challenges [6]. This involves expanding the commercial market for remote sensing applications and ensuring coordinated Earth observations, updated at least every three years. The policy also promotes the use of remote sensing in agriculture, forestry, biodiversity, climate change, natural disasters, energy resources, minerals, transportation, water resources, and weather forecasting. Thus, US remote sensing law recognises the broad applications of remote sensing in life sciences, national defence, and security, and provides a robust legal framework guiding the deployment, commercialisation, and protection of remote sensing activities.

The Canadian government has developed the Remote Sensing Law to institutionalise management strategies for radar technology, an advanced technology capable of observing the Earth day and night, under any weather conditions [1]. This strategy supports socio-economic development, particularly focusing on meteorological monitoring, weather, and climate observations across the country for defence-security purposes. It also seeks to maximise the potential of remote sensing in enhancing the value of industries and agriculture. Canada has further issued licensing regulations for sensors, data acquisition, processing, and sharing [7, 8].

The British government has reformed the 1986 Space Law to enhance the competitiveness of British space exploitation companies internationally, prioritising remote sensing applications in climate change response and positioning it as a core component of state management. Data derived from remote sensing are transformed into actionable insights for policymakers [9, 10].

The policy governs the management strategies and content for remote sensing applications by the European Space Agency (ESA), focusing on monitoring resources, protecting the environment, and addressing climate change issues. The strategy aims to monitor changes in land, oceans, weather and climate globally [11].

In the Federal Republic of Germany, the Satellite Data Privacy Act [12] governs security and foreign policy related to the commercial distribution and marketing of Earth remote sensing data obtained from satellites. This Act ensures legal certainty and enables German companies to use satellite applications in commercially viable enterprises and enter new markets. It was developed through close cooperation between relevant authorities in the Ministries and federal commissioners.

Most developed Asian countries, such as Japan, Singapore, and Indonesia, have space laws that regulate satellite launch activities and operations in orbit. These laws are framed in accordance with the full and lasting sovereignty of the State and its people, under international law. They provide a legal basis and certainty for domestic and international entities, optimising space activities for the benefit of the people and national productivity, and ensuring the sustainability of space activities for current and future generations [13].

The Space Law of Thailand [14] is designed to regulate the implementation of tasks such as studying and researching Space Law and policies, both domestically and internationally, providing comprehensive information on the development of Space Law and Policy, and developing research to support further studies. It also aims to coordinate and cooperate with government organisations, private and local agencies, and foreign universities, supporting the exchange of information and ideas about space at national and international levels. Space law has been a mandatory course at one or two universities in Thailand since 1999. Additionally, the main activities of Thailand's Space Policy include telecommunications, broadcasting, and remote sensing.

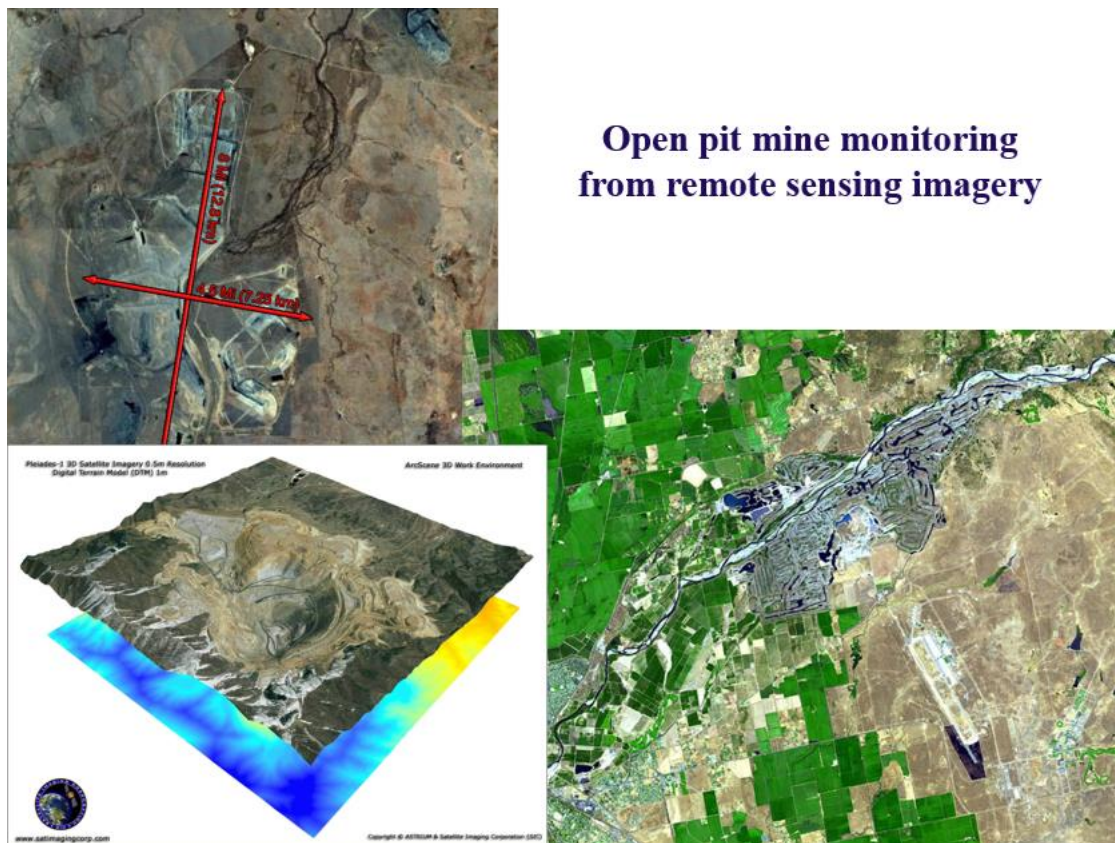
Singapore's remote sensing development policy focuses on developing booster rockets, building ground image receiving stations, and advancing remote sensing technologies. This includes processing ultra-high resolution remote sensing images and hyperspectral, radar remote sensing image processing. Applications of this technology span environmental resource monitoring, land use classification, agricultural management, forestry management, and mapping, addressing the scientific and business needs of Singapore and other countries in the region [15].

### **3. State management of remote sensing activities in Vietnam**

In the late 1970s and early 1980s, Vietnam's involvement in the Intercosmos Programme of former socialist countries laid the groundwork for the development of remote sensing

science. Since then, investment in space technology, particularly remote sensing technology, has been robust. On 4 March 2013, the Government issued Decree No. 21/2013/ND-CP, establishing the National Remote Sensing Department under the Ministry of Natural Resources and Environment. This body is tasked with the state management of remote sensing for purposes such as natural resource recovery, environmental protection, natural disaster prevention, and climate change response to bolster socio-economic development and ensure national defence and security [16]. Upon its establishment, this department undertook a thorough review of legal and related documents.

However, the practical application of state management of remote sensing only commenced in 2019 with the issuance of Decree No. 03/2019/ND-CP [4]. Over time, the management policies within this decree have revealed significant limitations and inadequacies. A major hurdle in the state management of remote sensing is the absence of comprehensive legal frameworks such as specific laws or decrees, coupled with technical standards, which results in a lack of technical regulations - essential for deploying applications and further developing remote sensing. Currently, the Government's programmes and projects related to remote sensing largely adhere to the Strategy for Research and Application of Space Technology to 2020, outlined in Decision No. 137/2006/TTg [17]. The absence of technical regulations and economic-technical norms complicates the assessment of remote sensing product quality, as standards vary across different agencies. Moreover, the lack of established processes and norms hinders the development of public services and applications in remote sensing [13] (Fig. 2).



## Open pit mine monitoring from remote sensing imagery

**Fig. 2. Remote sensing applications in geology and minerals.** Source: Satellite imaging corporation.

Additionally, remote sensing applications are predominantly managed by central agencies, with local implementations being scarce and underdeveloped [13]. The application of remote sensing at the local level is critically important for state management of natural resources and the environment. Furthermore, the planning and coordination mechanisms for long-term and annual remote sensing plans across ministries, branches, and localities have been neglected, leading to overlapping tasks, wasteful budget allocation, and confusion in plan organisation and expenditure distribution for remote sensing activities at the local level [13]. This significantly impacts organisations that use remote sensing for specialised purposes. Policies managing information and remote sensing data do not align with practical needs; regulations on the security, management, exploitation, and use of this data do not facilitate information sharing or broadly address societal needs to enhance public knowledge and promote social progress [13]. Regulations on handling violations remain generic and lack deterrent or preventive effectiveness.

Moreover, the highest legal authority on state management of remote sensing activities is currently only a decree, leading to a pervasive attitude of non-compliance and lax enforcement.

Given these challenges, there is a pressing need to develop and enact a comprehensive Remote Sensing Law. Such legislation would serve as a robust tool to unify management and

implementation of remote sensing activities, fulfilling the evolving requirements of state management in an era of international economic integration, particularly as Vietnam is a member of the World Trade Organization (WTO).

#### **4. Basic requirements in institutionalising the contents of state management of remote sensing**

To institutionalise the contents of state management in remote sensing activities, it is necessary to provide detailed instructions that unify remote sensing management nationwide and elevate remote sensing to a basic investigative field with modern scientific and technological levels, approximating the world's advanced standards. The development of management policies should align with the Party's viewpoints on socio-economic development and international economic integration and must be consistent with the Strategy for Research and Application of Space Technology until 2030. To achieve this, it is vital to inherit and enhance regulations that have shown positive effects while addressing the shortcomings and limitations of the existing legal policies on remote sensing.

Furthermore, it is essential to promote the mobilisation of social resources to develop remote sensing services and encourage organisations and individuals to invest in the production and development of remote sensing applications. These efforts should aim to enhance public knowledge and social progress and facilitate the use of remote sensing products in production, business, and other daily needs.

Given Vietnam's status as an official member of the United Nations, the World Trade Organisation, the Association of Southeast Asian Nations, and the Asia-Pacific Economic Cooperation forum, it is imperative to adhere to the regulations of these international bodies and honour international commitments. Accordingly, the construction and enhancement of the legal framework must be compatible with the content of international treaties and conventions that the Socialist Republic of Vietnam has signed or participated in.

#### **5. Propose contents to institutionalise state management of remote sensing in Vietnam**

Institutionalising state management of remote sensing in Vietnam includes the management of aerial and underground components, commercialisation, training, and international cooperation.

##### ***5.1. Airborne management***

Developing remote sensing satellites requires substantial investment, and given that satellites operate for a limited period [18], a long-term strategy for satellite design and manufacture is crucial. This strategy should clearly define the type, size, lifespan, and appropriate orbit of the satellites required.

Remote sensing sensors are critical for the data received on satellites and are linked to the applications of the data [18]. Thus, state management of these sensors should focus on using sensors capable of providing a variety of appropriate data to meet the diverse needs of ministries, branches, and localities, and on developing technical standards and regulations to ensure high-quality data reception.

Satellite orbit is directly linked to the data received, affecting data resolution, acquisition frequency, scan range width, and image capture time [18]. Orbit plays a vital role in the operation of remote sensing satellites. As with remote sensing sensors, the design of satellite orbits must be strictly managed to optimise the provision of high-quality remote sensing images, satisfying the needs for remote sensing data while ensuring the long-term operation of the satellite and minimising conflicts and negative impacts.

Remote sensing signals, characterised by their frequency and data properties, require careful management [18]. With limited frequency resources and the need to share frequency ranges with other services, it is essential to develop plans and frequency protection strategies for remote sensing data receiving stations and satellites to avoid interference with other systems. For commercialisable high-resolution remote sensing data, financial and security policies should be established to effectively exploit these signals, such as selling or exchanging signals with foreign partners.

### ***5.2. On the ground parts management***

Satellite data receiving stations, which are costly and provide essential input data, must be managed effectively to ensure long-term and safe operation, avoiding the wastage of state investment [18]. These stations should be capable of receiving signals from multiple satellites and be upgradable to accommodate new satellites as necessary. A coordination mechanism between satellite data receiving stations and satellite control agencies should be developed, along with plans to avoid signal interference and construction impacts on data reception.

The satellite control system, crucial for the success of the satellite imaging system, requires effective management to ensure quality imaging [18]. Mechanisms to regulate satellite operation during emergencies, such as natural disaster monitoring and ensuring national defence and security, are also needed.

The remote sensing data processing system must adhere to standard data processing levels for different purposes, requiring specialised hardware and software to process various types of remote sensing data for professional purposes. The processing for each type of product is different and requires individualised supporting data. Processing time increases the time it takes to produce a product and the cost of that product, so the process must be optimised for each datatype.

Remote sensing data is a high-tech product with significant economic value, must ensure accurate information extraction and effective utilisation, supporting commercialisation and national defence and security. State management of remote sensing data must ensure information is extracted accurately and effectively, ensuring proper technical processes, exploiting great value from a commercial perspective, and meeting national defence security effectiveness as well as natural disaster prevention [18]. It is necessary to have a policy to encourage the application of remote sensing data in monitoring natural resources and the environment. Remote sensing data is mostly digital data that is prone to loss, so strict regulations on data copyright, storage, and management are essential, along with mechanisms



for data provision and the setting of fees for data usage. Organizations and individuals have the right to act as agents to offer data and provide regulations on data copyright laws.

The remote sensing data transmission system, critical to the success of remote sensing operations, requires specific management policies to ensure a synchronised operating mechanism. Regulations on the licensing of remote sensing activities should grant specialised authority to licensing agencies for the use and business of these activities.

Remote sensing human resource management should include training at undergraduate and postgraduate levels both domestically and abroad, as well as enhanced training in localities to update knowledge for officials working in remote sensing.

For the management of remote sensing research and application, it is crucial to use new materials, enhance image classification, and processing technology to improve the efficiency of remote sensing technology applications. By 2030, it is necessary to develop software related to remote sensing image processing in Vietnam, promoting internal resources combined with technology transfer and expanding international cooperation.

Regulations on cooperation in remote sensing with developed countries through international scientific research projects on Earth sciences and joint programs to address regional and global issues should be stipulated. Additionally, the contents of cooperation with neighbouring countries and other nations on remote sensing should be defined to provide common information for the entire region.

## **6. Conclusions**

Institutionalising the management of remote sensing and developing regulations to apply remote sensing in various scientific and life branches are crucial. Gradually completing the Remote Sensing Law will create a legal corridor to promote the development of remote sensing technology, address deficiencies in current remote sensing management policies, ensure accurate decision-making processes, and lay the foundation for developing remote sensing technology in all areas of socio-economic life, thereby ensuring national defence, security, and environmental monitoring.

### **CRediT author statement**

Thi Phuong Thao Vu: Original draft preparation, Writing - Reviewing and Editing; Quoc Hung Le: Conceptualisation, Project administration, Reviewing and Editing.

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### **COMPETING INTERESTS**

The authors declare that there is no conflict of interest regarding the publication of this article.

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