A Governance Framework for the Geospatial Information Centres (GICs) in Developing Countries

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ABSTRACT

Spatial information and analysis are very beneficial for decision-makers and planners in preparing regional development plans to optimize development returns. There are numerous issues with the process of building GIC databases, especially in developing countries, mostly related to weak governance, one of which is the lack of adequate tools for gathering and arranging data; the absence of standardized information methods and recording; the inability to access this information through a working method; information preservation and recording techniques; the inability to use specialized hardware and software, etc. Egypt began creating a total of 27 GICs to cover all governorates. A questionnaire was used to learn more about the current GIC governance in four GICs, which only accept responses. It deduced that each centre has a different administrative structure and no precise exercise of good governance powers; it was evident that the GIC's governance framework was lacking. Three international GIC governance frameworks were revised, to deduce the perfect governance framework with some modifications to be more suitable for Egyptian GICs and other developing countries in order to close the gap in recent Egyptian GIC governance. The proposed framework illustrates departments and organizational structure, "which includes departments like data analysis, networks, cybersecurity, and the collection of geospatial and statistical data," human resources represented in personnel, tasks, and responsibilities, in addition to the data governance model and the controls for classifying collected data in light of data handling policies, and finally delivery channels for hardware applications and established geospatial data.

KEYWORDS

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إطار حوكمة مراكز المعلومات الجغرافية المكانية في البلدان النامية

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ملخص البحث

أصبحت المعلومات والتحليلات المكانية مفيدة جدًا لصناع القرار والمخططين في إعداد خطط التنمية الإقليمية بهدف تحسين عوائد التنمية. وهناك العديد من القضايا المتعلقة بعملية بناء قواعد بيانات مراكز المعلومات الجيومكانية، وخاصة في البلدان النامية، معظمها يتعلق بضعف حوكمة تلك المراكز، وافتقارها إلى الأدوات الكافية لجمع البيانات وترتيبها؛ غياب أساليب المعلومات الموحدة والتسجيل؛ عدم القدرة على الوصول إلى هذه المعلومات من خلال طريقة عمل ممنهجة؛ ضعف تقنيات حفظ المعلومات وتسجيلها؛ بالإضافة الى عدم القدرة على استخدام الأجهزة والبرامج المتخصصة المرخصة، إلخ. وبدأت

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مصر في إنشاء 27 مركز معلومات جيومكاني لتغطية جميع المحافظات. وللتعرف علي حوكمة تلك المراكز تم استخدام الاستبيان لكن في أربع مراكز معلومات حكومية وهي التي استجاب القائمين عليها للرد علي الاستبانة. واتضح من ذلك أن كل مركز لديه هيكل إداري مختلف ولا يوجد ممارسة دقيقة لصلاحيات الحوكمة الرشيدة؛ كما اتضح غياب وجود إطار حوكمة لمراكز المعلومات المكانية الحكومية. ولاستنتاج إطار الحوكمة المثالي تمت مراجعة ثلاثة أطر حوكمة دولية لمراكز المعلومات الجيومكانية، مع اجراء بعض التعديلات لتكون أكثر ملاءمة لحالة مراكز المعلومات الجيومكانية المصرية وغيرها من البلدان النامية من أجل سد الفجوة في حوكمة مراكز المعلومات التي تم رصدها وتحليلها. وتم تقديم إطار حوكمة مقترح اشتمل علي توضيح تدرج الأقسام والهيكل التنظيمي الذي يشمل "أقسامًا مثل تحليل البيانات، والشبكات، والأمن السيبراني، وجمع البيانات الجغرافية المكانية والإحصائية"، بالإضافة الي الموارد البشرية ممثلة في الموظفين ومهامهم ومسؤولياتهم، واقتراح نموذج لحوكمة البيانات وضوابط تصنيف البيانات المجمعة في ضوء سياسات التعامل مع البيانات، وأخيرًا قنوات التسليم لتطبيقات الأجهزة والبيانات الجغرافية المكانية المعمول بها.

الكلمات المفتاحية: الحوكمة، مراكز المعلومات الجيومكانية، صناع القرار، التنمية المستدامة.

INTRODUCTION

In the context of the global economy, any nation, area, or location must show that it can make the most use of its resources, seizing the chances presented by the expanding market, and creating new ones (Borza, 2012). This is contingent upon a determining element sometimes referred to as "governance," which is the "quality of institutions" (public or private, formal or informal) (Stiglitz, 2006). GICs were created to identify planners, implementers, and decision makers around the world engaged in regional development processes that require access to spatial information as well as spatial tools and analysis. GICs are frequently new in developing nations in general and Egypt in particular, which have no clear definitions of tasks and responsibilities in addition to the ambiguity of administrative structures, proper human resources and equipment cannot help them achieve the intended goals, a significant divide exists between the collection, processing, and preparation of data from its original sources and forms. This is due to a lack of, or even the loss of, necessary hardware and software among those involved in the preparation and processing of such information. This hinders the use of the GIC by traditional information systems and the general workplace environment. Reaching a proposed framework for achieving good governance for GICs in developing countries, including Egypt, in a way that enhances their required equipment, human resources, special departments, and administrative structures, as well as the identification of tasks and responsibilities that are recently missing. This will contribute directly to strengthening the governance through the capabilities of administrative units to carry out the tasks assigned to them at a high technical level and enhancing the principles of decentralization in supporting decision-making process for development which influencing the quality of life and achieving sustainable development plans (Andrijevic et al., 2020).

1. Background

The term "governance" gained widespread usage, particularly following the restructuring of international organizations. It outlines who oversees making decisions, who can act on behalf of the organization, and who is responsible for the performance and behavior of the organization and its members (CGI, 2021). The term "governance" is multidimensional and can indicate several things depending on the situation. The term "governance" refers to the arrangements of institutions and policies in this context (Buchir and Detzel, 2023). OECD (2015) mentioned the concept of governance as "the system that the establishment uses in the process of supervising and controlling its operations; it also represents the system through which rights and responsibilities are distributed to the various working parties and stakeholders; and it also defines the rules

and procedures for making decisions that relate to the establishment." IFC defines it as "the system and structure through which companies are managed, monitored, and relationships between all parties and stakeholders are monitored" (ADGC, 2021). Al-Shammari (2010) and Abdul-Malik (2008), agreed "that they are the procedures, policies, and practices to determine the method of managing the organization's operations to achieve its goals and achieve the best return for all stakeholders, through an organizational structure, governing laws, and capabilities, whether human or material, to achieve the goal of governance in particular, the organization in general, with the importance of integration with the surrounding environment.

Incompetent governance one of the challenges faced the developing countries to achieve development adaptation goals and targets which lead to governance success (Berrang-Ford et al., 2019), enhancing nation's capacity through establishing GICs is one of many ingredients and pillars of governance success, through raising levels of quality and efficiency, in addition to; (A) The legal framework, which determines the rights of each of the main parties concerned with the institution, its responsibilities and powers, and the committees and departments affiliated with the institution, as well as the penalties for violating those rights, neglecting responsibilities, and exceeding competencies (Al-Haizan, 2016). (B) Monitoring framework, which includes the bodies and departments entrusted with ensuring the implementation of governance procedures, and these bodies may be governmental or non-governmental (Mikhail, 2015). (C) Organizational framework consists of two parts: the company's or institution's bylaws and its organizational structure, which lists each member's name and competencies along with the capabilities unique to that structure in terms of material or human resources, tools, and equipment that greatly aid in accomplishing the goals of the organization and its departments (Belkacem, 2008). (D) Preparing and releasing information in line with globally recognized qualitative standards, sharing it with interested parties, and doing so via relevant information channels and information technology (this is connected to the creation of the GIC) (Mercier-Suissa et al., 2016). (E) The efficiency of governance systems varies according to the nature of each region and depends on multiple factors, including the availability of resources and the degree of financial independence, the extent of accountability and comprehensive participation in decision-making processes, and the authority and ability to provide and maintain public services (UNDDR, 2021).

In the modern world, geo-positioning techniques are widely employed and applied regularly, by employing georeferenced data, or "geodata," to be able to navigate on land, in the water, or the air (Taha et al., 2021). The GNSS is intimately related to the requirement for this kind of data, which is required to optimize logistical services, construction, agriculture, economic, and social advancements (Hotz, 2005). Hence, the GIC is specialized in the applications of geospatial technologies to help in a deeper understanding of many of the issues related to the spatial dimension that the population suffers from and related to environmental, social, and economic problems. These centres are using geographic information, spatial information, geospatial information, geo-information, and location-based data, which can also be used interchangeably with geodata (UN-GGIM, 2018). Therefore, geospatial technology provides a flexible space for studying many different and distant phenomena that are based mainly on the existence of the geographical distribution of the phenomenon regardless of its nature, such as climate change, environmental protection (desertification, land depletion, urban growth), distribution of services, hot spots for disease outbreaks, economic conditions and distribution of marginalized and poor families, distribution of crimes, etc.

The goals and tasks of establishing GICs are numerous as; carrying out development research to inform national programs and public policies that assist SDP; building a geospatial data bank and archive that aids in the work of decision-makers (GDA, n.d); offering courses and technical support to people and organizations working in geographic data technology; to gain a better understanding of geospatial applications and the extent to which they might be beneficial, it is important to foster respectful discourse and involve the local community and pertinent institutions; creating atlases and conducting research on soil specifications, plant health, and marine habitat classification; spectral satellite data analysis, research, geographic data, and satellite images are provided; evaluating the effectiveness of government networks and systems and making improvements to them (IEGA, n.d); serving as a single point of contact for organizations that use the institution's technical services (IEGA, n.d); encouraging geospatial innovation and interacting with private businesses and providers of geospatial services.

2. Methodology

This study demonstrates four main work stages (Fig. 1). The introduction considers the first stage to clarify the research problem and goal. The second stage is about research background, through which governance concepts and their problems in developing countries are highlighted, in addition to learning about the shortcomings and deficiencies related to GICs in developing countries. The third stage goes beyond the GICs in international cases by analyzing three GICs using the deductive approach, two of them in developed countries and one in a developing country, which is similar to the Egyptian case, which will be diagnosed using questionnaire methods with the GICs in charge. The gap in GIC governance requirements between the international cases and the Egyptian case will lead to the fourth stage of this study as a trial to close this gap by proposing a framework for GIC governance in Egypt and developing countries that have the same development characteristics. The study will be concluded with a group of recommendations for better implementation of the proposed framework after a discussion that highlights the obstacles and challenges faced by the study.
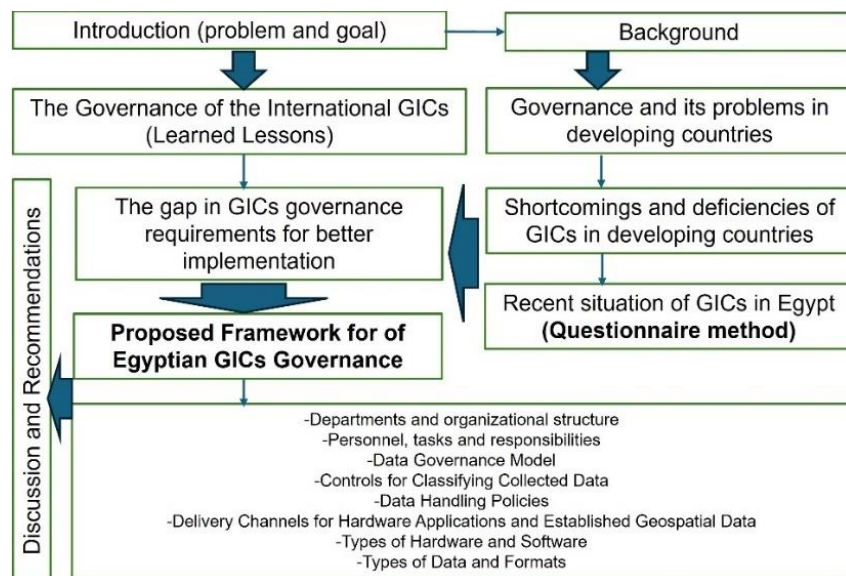

Figure (1): The research process. Source: Authors

2.1 The Governance of the International GICs (Learned Lessons)

Developing countries suffer from many problems due to the weakness of technological and human capabilities, including the lack of the necessary hardware and software, the severe gap between the processes of collecting, preparing, and preparing data from the original sources, and this affecting the establishment of the GICs. There are many international experiences in establishing GICs; two different GIC models from Germany and the USA will be chosen to fully benefit from GIC good governance, as both countries came first in the fifth rank of around 50 countries in the readiness of geospatial information, institutional capabilities, level of flexibility to support users, and industrial capacity (GMC, 2017; 2019). The GIC in the Kingdom of Saudi Arabia will also be analyzed as a model similar to the Egyptian case to determine the extent of the centre's success in achieving its goals in developing countries.

2.1.1 Brandenburg's State GIC governance "Germany"

- The Centre is controlled by the Inter-Ministerial Committee for Geographical Information, aiming to provide official geographic data, spatial data, and metadata in a centralized and unified form for public use with the requirements of public administration, enterprise, business, and research,
- Establishing spatial data infrastructure through the strategic planning and coordination centre in the state of Brandenburg through the national project SDI Germany, (Geoportal Brandenburg, n.d),
- Determine the data required at the European Parliament, the European Council, and the state level,
- Preparing state surveys and conducting surveys for the strategic planning and coordination centre,
- Create a central portal for all users, providing correct data upon request to decision-makers for sound planning and successful management encouraging integrated teamwork among government agencies, especially those working in the fields of infrastructure, planning, environmental protection, and municipalities,
- Use and prepare map applications, spatial data, and geographic services using metadata stored in the system,
- Developing the centre's data level from more than hundred data sources from the public sector in addition to official geospatial data and specialized data and placing them in groups,
- The Centre carries out coordination tasks with the European Community (INSPIRE) (Geoportal Brandenburg, n.d),
- Follow up on the implementation of the e-Government law as a point of contact for providing metadata, spatial data, and geographic data services,
- Allowing state authorities to use the general basic components of information technology provided by the state to fulfil their obligations,
- Liaison for all matters related to the "Strategic Planning and Coordination Centre" regarding cross-border cooperation with other federal states for coordination between project groups,
- Exchanging experiences with other actors in the National Strategic Defense Initiative (NSDI),
- Supporting easy access to geospatial services through map applications, geospatial services, and a large number of geographic data sets from the state of Brandenburg, (Geoportal Brandenburg, n.d),

- The GIC's committee meets at regular intervals under the supervision of the Ministry of the Municipal and Interior in addition to the State Survey and Basic Geographical Information Brandenburg, (Geoportal Brandenburg, n.d),
- The GIC contains a department for administration planning and another for technical tasks, in addition to a cybersecurity department to keep networks safe from hacking,
- Data has different policies for collecting, classification, distribution, remediation, and preservation,
- Data is tabulated in forms, like CSV and XLS, while the geographic data is provided in SHP, KML, and KMZ files.

2.1.2 California's State GIC governance "USA"

- It is a centralized geoportal portal for open geographic data, which includes approved data and applications from many entities and operates through the ESRI ArcGIS Online platform to access and display data and maps,
- The mission of the GIC is to promote a greater understanding and use of the benefits of GIS, facilitate collaboration across California by supporting the collection, acquisition, sharing, and dissemination of GIS data and standards,
- Coordinating between the entities that benefit from the GIC and making agreements between entities to prepare consultations from these entities who have common work requirements with the GIC, including state government, the federal government, city government, California GIS Council, councils of regional geographical information, special regions, educational institutions, private industries, public and private facilities, etc (CSG_training, n.d),
- The GIC makes many tools available to users to help locate and display datasets as well as create their own maps,
- The GIC allows the user to combine and choose the data set that he wants to benefit from and display it on maps through a very diverse set of applications based on the data sets available and published in the centre's electronic portal (CSG_organizations, n.d),
- Coordination between bodies, institutions, and departments that implement geographic information systems at the level of administrative units,
- Executive departments participate in an internal regulatory review and approval process before publishing data on their portal. This internal review can benefit from existing governance models within the organization, and publishing contributors contribute to pushing the portal towards increasing data content, quality, and accuracy,
- Ensuring compliance with all security, privacy, confidentiality, and intellectual property rights laws, rules, and regulations. The proposed broad data governance levels take a multi-tiered approach that provides oversight in an efficient and streamlined process,
- Studying the needs of the administrative unit departments for geographic information systems software to achieve integration between data networks between those departments and the GICs,
- Qualified staff in mapping production and database analysis in addition to geographic applications programmers,
- A clear strategy for creating data to keep it managed at high quality level through using database structure to support the data processing,
- GIC is equipped with workstations and last-generation laptops, which are operated by ESRI and Microsoft products,

- Ease of cooperation with stakeholders and partners and exchanging benefits within the limits permitted by the possibility of exchanging data.

2.1.3 National Geospatial Center (NGC) governance "KSA"

- Organising geospatial data collection, sharing, exchanging, saving, updating, maintaining, and publishing on the National Geoportal Platform (NGP) in accordance with the principles of ease of use, security, and subject to update and growth. NGC emergers from general authority of survey and geospatial information, it serves as a national reference for geospatial information governance. It also prepares standards and criteria for the complementary use of national geospatial information (NGC, n.d),
- NGC classified data through many controls like data sharing, disposal, and archiving to make it easy to handle and safely processed,
- NGC set up routes of data delivery for hardware applications and recognized geographic information systems,
- NGC is working as a platform to provide geospatial information for publishing and sharing with partners from different governmental agencies and data providers, in addition to beneficiaries, whether governmental or private organizations,
- Help in increasing the level of geospatial information readiness at the international level and supporting geospatial digital services (NGC, n.d),
- Direct the decision-makers to take successful actions and make their spending more efficient,
- Taking the responsibility of developing, overseeing, managing, and keeping an eye on the sector in the Kingdom in a way that promotes security, quality, and performance,
- Users can access and display datasets and create custom maps with the many tools provided by the NGC,
- Developing the national geospatial infrastructure, and guidelines, rules, and standards pertaining to the sector must be established and updated in order to accomplish integrated use of the geospatial information system among pertinent authorities and to guarantee adherence to stated rules and standards (NGC, n.d),
- The NGC represents the national level of geospatial information centers. It works to achieve national policies and improve the geospatial information industry at the international level,
- Providing basic geographical maps of the country and related services in coordination with the competent authorities. Encouraging and facilitating informational linkage between different levels of data sources and systems centres in the regional and local framework,
- The NGC can supervise a group of regional centres at the state level to support regional development plans, investment, and other sectors. In the future, a group of local centres can be established at the governorate level that are concerned with creating and compiling local databases that support regional and local development plans for the governorates.

2.2 Learned Lessons from the International GICs

A successful GIC depends on the exact identification of personnel and tasks and the use of different controllers to keep data safe and handled. As data is the main cornerstone of the GICs, there is a data governance system and delivery channels, in addition to using exact data formatting through licensed software and updating hardware. The recent governance system of the international GIC cases is illustrated in

Table 1. The deductive approach is used to get out the aspects of the governance framework.

Table 1. Analysis of the recent governance system of the international GIC cases

Aspect/ centre of	Brandenburg	California	KSA
Organizational departments	●	●	●
Exact identify for personnel and tasks	●	●	●
Collecting data controls	●	●	●
Policies for data handling	●	●	-
Data governance system	●	●	-
Data delivery channels	●	●	-
Data formatting and types of definition	●	●	●
Licensed software and hardware	●	●	●
Full GIC governance	Full	Full	Semi

Source: Authors

2.2.1 Organizational departments

Data is processed through three main departments: the first is about the administration process to manage and assign different tasks, while the second is about technical works as data will be processed and maps produced. The third department is for cybersecurity to keep servers safe against harmed attacks.

2.2.2 Personnel, tasks, and responsibilities for the GICs

- The most important human resources (individuals) needed for GICs are; Systems manager, Geographic information systems analyst, Database Supervisor, Data processing supervisor, Supervisor for map digitizer, Computer systems administrative supervisor, Programmer,
- Conducting the necessary studies and research to develop comprehensive GISs to update databases,
- Establishing, developing, and monitoring national standards and specifications related to geographic information systems in the administrative unit,
- Operating and maintaining the GIS network, linking it to the GIS databases in the country, and securing its data,
- Providing technical assistance and advice to government agencies and affiliated administrative entities on matters related to geographic information systems,
- Cooperation with international organizations and parties concerned with international geographic information systems,
- Preparing the necessary mechanisms to meet local requirements for data, information, and geospatial indicators,
- Supporting clients and residents of the administrative region with geospatial data, statistics, and models necessary to support decision-making at various levels.

2.2.3 Collecting data and controls

Data is collected on a unified basis to be handled and processed following different ways of controlling data safety.

2.2.4 The governing factors in data handling chains

GICs depend on the following data governance chains: supply, review, classification, correction, distribution, processing, archiving, sharing, and analysis. These are very important processes in filling the gaps that may appear during the various sub-processes, as well as the policies followed at the various stages.

2.2.5 Data governance

Most international GICs build data strategy and management to ensure better data processing through structuring databases and providing data processing support.

2.2.6 Data delivery channels

In addition to audio and signal channels, SMS messages, and multimedia messages, there are connection channels such as basic and smart mobile phones, tablets, and personal digital assistants.

2.2.7 Data formatting and types

Various forms of data, including tabular, geographic, and other data, are utilized in the GICs.

2.2.8 Hardware and software for data processing

In all international cases using licensed software systems for operating or cyberwar for protection against hacking, hardware is diverse according to the tasks and personnel number.

2.3 GICs in Egypt

Egypt developed a future vision to confront the existing challenges, the most important of which are the severe centralization and poor state of public services, in addition to the weak management of state-owned assets. The vision was as follows: "An efficient and effective government administrative apparatus, characterized by professionalism, transparency, justice, and responsiveness, providing quality services and subject to accountability, increases citizen satisfaction and contributes strongly to achieving the state's development goals and the advancement of the Egyptian nation (SCI, n.d). To achieve this vision, and within the framework of the state's plan to develop the administrative apparatus and coordinate with the concerned authorities and governorates to create an electronic system for the work cycle, the proposal of GICs was resorted to achieve the availability of information to decision-makers, achieve quality standards, expand the use of technology, sustain reform processes, achieve transparency, and set priorities (SCI, n.d).

2.3.1 Goals and tasks of the Egyptian GICs

GICs aim to unify base maps, build geographic databases with the same coordinate systems, achieve integration of the spatial information infrastructure, support complete and accurate decision-making, achieve the principles of integrity and transparency, achieve citizen satisfaction, and combat corruption in all its forms. According to their tasks, the GICs play important roles in monitoring urbanization and resolving the issues facing it, especially random urban growth and agricultural land, legalizing conditions, and reconciliation, in addition to many other tasks (see Fig 2).
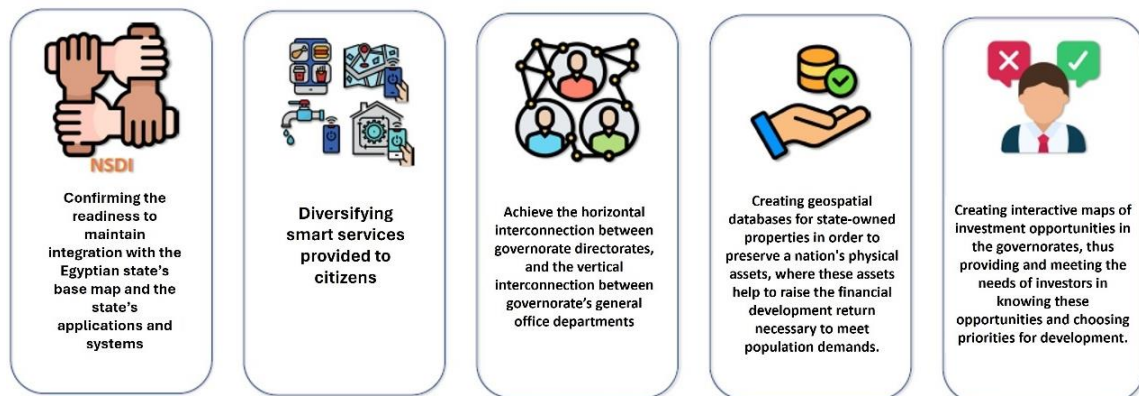

Figure (2): Goals and tasks of the Egyptian GICs. Source: Authors

2.3.2 Egyptian GICs Recent Features (find gaps)

Egypt has a vision to establish 27 GICs representing all governorates; 22 GICs are already fully working, but not all have the same starting point and technical capabilities, and the departments of GICs differ in each governorate, while 5 GICs start the assigned tasks. To discover the characteristics and features of the established GICs in Egypt, a questionnaire was conducted with GIC head managers. Only four persons in charge respond to a questionnaire that seeks to clarify the internal features, like the number and qualifications of the staff, and find out how to use the data through the number of hardware and different types of software. This is besides an open section to get the problems and challenges facing GICs (Table 2).

Table 2. Characteristics and Features of GICs in Egypt

GIC name	NM of internal department	NM of personnel	NM of hardware equipment	NM of Licensed software	horizontal interconnection	vertical interconnection	A specialized personnel
Assiut	No	2	2 PC	Cracked	No	No	semi
Alexandria	No	9	5 PC & 4 workstations	Cracked	No	semi	semi
Ismailia	No	4	7 PC	Cracked	No	No	semi
Kafr-elshiekh	13	22	14 PC & 5 workstations	Cracked	Yes	Yes	full
Problems and challenges facing GICs	▪ Accuracy and lack of data in digital files of data received from multiple parties, and some of them conflict. ▪ Lack of databases for state properties and assets. ▪ Lack of human labour and their qualifications for work requirements and weak human capabilities and knowledge of the software required in accordance with the centre's tasks. ▪ Lack of technological capabilities and lack of surveying equipment and computers. ▪ Lack of licenses and servers. ▪ Lack of interactions between departments within the centres and between external departments in other directorates or internal departments within the governorate general office. ▪ The lack of platforms for all of the centre's tasks and the lack of unification in creating databases between different departments as well as between geospatial data centres in other governorates to maximize development returns at the national level. ▪ The severe gap between the processes of collecting, processing, and preparing data from its original sources and forms and its raw sources and converting them to the required form for the beneficiary or user. ▪ Technical problems related to methods of preserving and recording many and varied documents and information related to matters of development and spatial planning.						

Source: Authors

SWOT "Strengths, Weaknesses, Opportunities and Threats" analysis will be used to diagnose the recent situation of GICs in Egypt to determine the proposed framework to develop the GICs governance system (Table 3).

Table 3. SWOT analysis for recent GICs in Egypt

Strengths	Weaknesses	Opportunities	Threats
- The government has a vision to cover all governorates with GICs. - Determining goals and	- No identification of tasks and responsibilities. - No clear structure for the internal departments. - Personnel qualifications do not meet the position requirements. - Collecting data and controls are not assigned.	- Centres are characterized by flexibility and the ability to change, harmonize, collect,	- No clear strategic plan for action according to the vision and priorities of the level of dealing with the centre (national, regional, and local).

| forming follow-up committees and specialists. | - Governing factors in data handling chains are not determined.
- No data governance system.
- Data formatting and types are not unified.
- Using unsuitable hardware for missions while the software is mostly cracked.
- No cyber security specialist was assigned. | report, and publish, | - It is not obvious how the GIC will create horizontal and vertical relations with other authorities and sections. |

Source: Authors

3. Proposed Framework for Egyptian GICs Governance

The goal of the suggested framework is to bridge the gaps in the Egyptian GICs' weak governance that appeared through comparison to the international GICs. The main points to be revolve around three main parts. The first part is about the administrative structure, the required personnel, and the clear definition of tasks and responsibilities. The second part is about the data, how the governance model allows for better data flow in addition to identifying data handling policies and controls. This framework will be completed by pointing out the types of hardware and software which is the third part.

3.1 Proposed Departments and Organizational Structure

It is proposed that the GIC include three departments, and each one will be subdivided into a number of offices, as illustrated in figure 3.
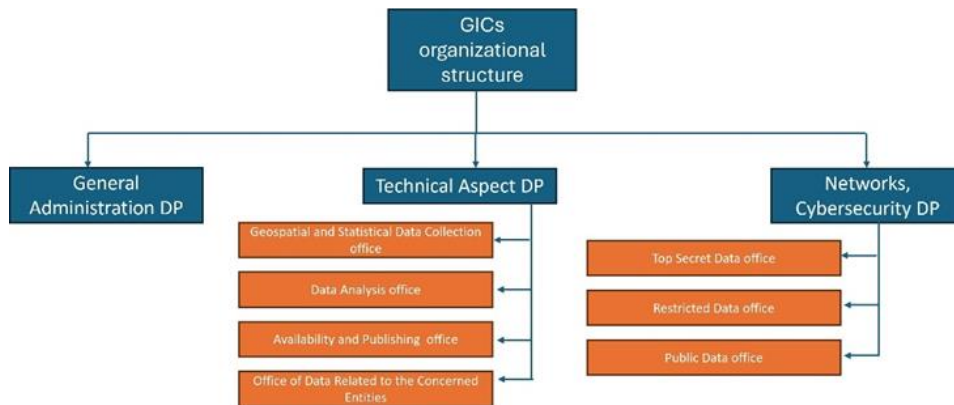

Figure (3): Proposed departments and organizational structure for the Egyptian GICs
Source: Authors

3.2 Personnel, Tasks and Responsibilities

The full clarification of the proposed personnel who will carry out the different tasks and responsibilities will be detailed in Table 4.

Table 4. Proposed personnel, tasks and responsibilities for the Egyptian GICs

Department	Office	Position	Number of staff	Tasks and responsibility
General Administration	Director of the GIC		1	Supervisor of all technological and administrative works at the GIC
	Representative of the centre's departments		3	The link between each department and the general administration department.
Technical Aspect	Databases and Data Analysis office	Database Administrator	1	Supervisor of all database work (incoming - matching - analysis - validity - availability - publishing)
		Database Supervisor	1	Supervises data and content, staff training, and errors correction
		Data representative	1	Responsible for the data collected.

		Data specialist	1	Data protection according to requirements and controls
		Data classification	1	Responsible for reviewing and approving the levels of data classification and determining the time frame for updating the data.
	Maps Production	Geographic information systems analyst	2	Implementing all procedures and applying standards for geographic information systems in accordance with established methodologies and submitting reports on achievement periodically
		Quality assurance	1	Providing reports related to data quality and issuing periodic reports
		Quality follow-up	1	Follow up on those responsible for producing information systems outputs in order to achieve the best possible practices
		Numberer and Cartographer	2	Organizing incoming data, dealing with maps, classifying them according to classification, drawing what can be requested, making modifications, updating, and clearing.
		Data entry	1	Entering data in order to classify it in controlled formats
		Remote sensing specialist	1	Responsible for reviewing and approving remote sensing data and determining its extent and suitability for the GIC and the possibility of dealing with it and its applications.
		Maps editor	2	Specialist in mapping and its spatial analysis applications
		Data archiver	1	Follow up on archiving and saving data according to the code
	Availability and Publishing	Publication references and approvals	1	Handles, accesses, uses or updates data
	Geographic applications	Applications programmer	1	Designing user interactions on applications and ensuring the quality of application performance on various types of devices
		Browser programmer	1	Using programming languages to develop various systems
Networks, Cybersecurity	Network Engineer		2	Responsible for building and maintaining computer network systems
	Top secret, restricted, public data offices.	Cyber security specialist	3	Responsible for protecting IT systems to prevent data breaches and keep them safe from hackers, viruses and other potential problems.

Source: Authors

3.3 Controls for Classifying Collected Data
Appropriate security controls are defined and implemented to protect the structure of data and ensure that it is handled, processed, shared, and disposed safely. Unclassified data is defined as "restricted" until it is properly classified. Below are the controls for data classification: (Tags protection, access, use, storage, data sharing, data retention, disposal and archiving).

3.4 Data Handling Policies
- Collection policies: These are concerned with the methods and means of collecting data from sources, including sources evaluated according to category, credibility, quality, and impact of the statement.

- ▪ Classification policies: concerned with understanding the importance and type of data in terms of sector and level (national, regional, or local).
- ▪ Security policies: understanding the level of availability of data in terms of restricting or not restricting the possibility of sharing the data (top secret, confidential, restricted, available, or other).
- ▪ Data distribution and linkage policies: In the event that the statement is completed, it is responsible for distributing it internally to the competent department and office.
- ▪ Review, correction, and remediation policies: Calibrating the statement and measuring its quality or validity once it reaches the relevant department through internal mechanisms, such as measuring against international standards or local indicators.
- ▪ Preservation and archiving policies: This means that if it is possible to use the data, there will be the possibility of saving the data in the desired form and in any form of specialized software.

3.5 Data Governance Model

The data governance model will illustrate the different proposed procedures for dealing with the data as the main pillars for the GICs, and the governance of the data will provide successful work. The model will be proposed in the figure 4.
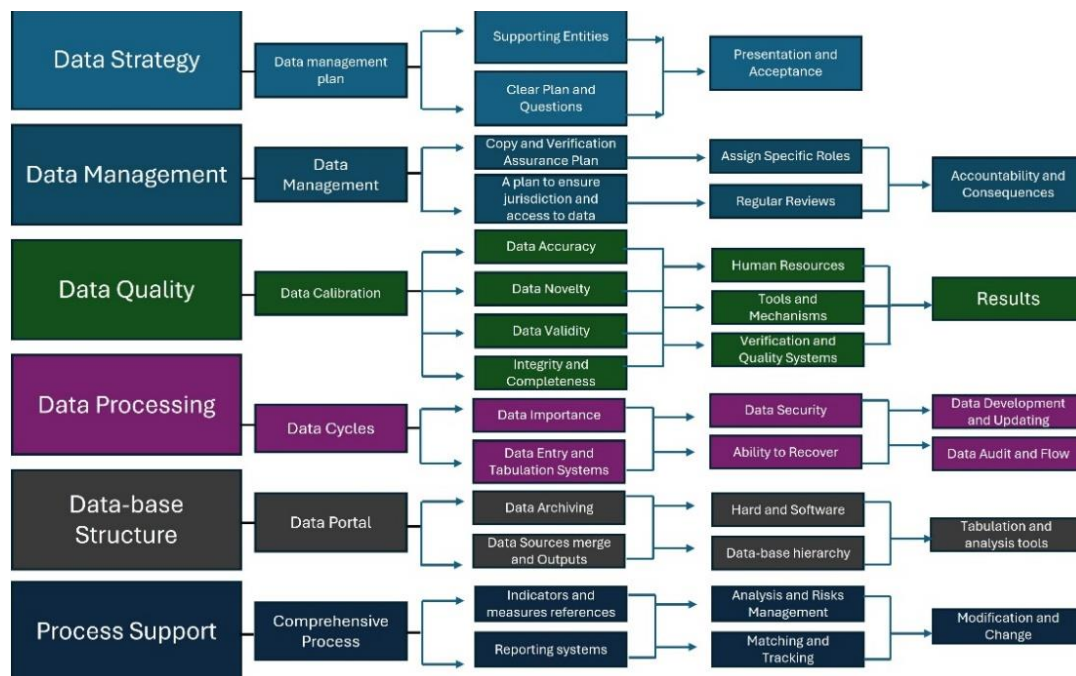

Figure (4): Data governance model for the Egyptian GICs
Source: Authors

3.6 Delivery Channels for Hardware Applications and Established Geospatial Data

• Connection channels (depending on devices) like ordinary mobile phones (with simple capabilities), smart phones, tablets and personal digital assistants (PDA), • Audio channels, • Signal channels, • SMS messages and multimedia messages, • Data channels.

3.7 Types of Data and Formats

Different types of data are selected to be used within the GICs, such as the tabulated data, geographic data and other data, all types formatted are given in the table below.

Table 5. Types of Data and Formats for the Egyptian GICs

Tabulated data		Geographic data		Other data	
data	format	data	format	data	format
Comma Separated Values	CSV	ESRI Shapefile	SHP	Hypertext Markup Language	HTML
MS Excel file extension	XLS	Representational State Transfer	REST	Microsoft Document	DOC
JavaScript Object Notation	JSON	Keyhole Markup Language	KML	Text File	TXT
Extensible Markup Language	XML	Zipped Keyhole Markup Language	KMZ	Joint Photographic Experts Group	JPG
Resource Description Framework	RDF	Geographic JavaScript Object Notation	GeoJSON	Portable Network Graphics	PNG
Open Document Format	ODF			Graphics Interchange Format	GIF
Open Document Store	ODS			Tagged Image File Format	TIFF
Tab Separated Values	TSV			Portable Document Format	PDF
				Compressed File	ZIP
				Open Document	ODT
				Binary File	BIN

Source: Authors

3.8. Types of Hardware and Software

To perform flawlessly, the GICs need to support higher versions of workstations for the resident engineers, while the movable engineers should have laptops linked to the GIC's internal network, and the software should be licensed from original sources such as ESRI and Microsoft Products in addition to VM WARE and DMPS which is "Ready-to-Use Data Protection Kit (Fig. 5).
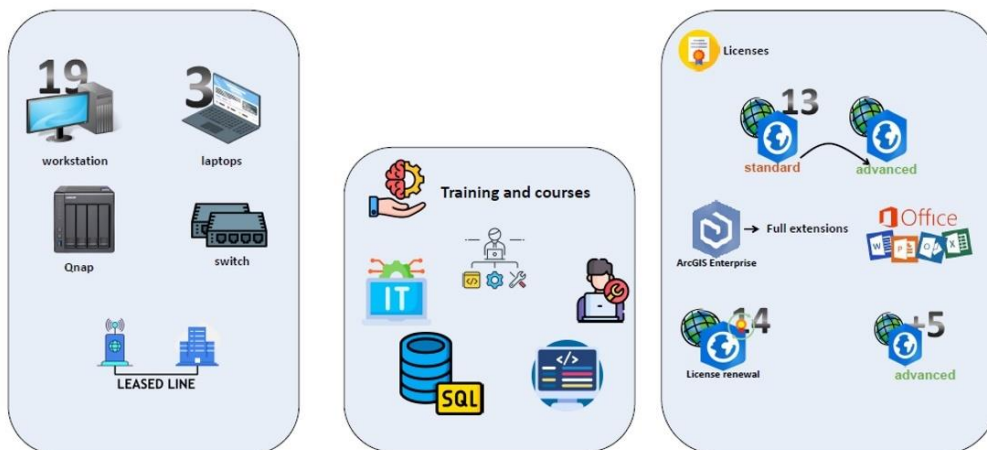

Figure (5): Required types of Hardware and Software for the Egyptian GICs
Source: Authors depending on Setia geosolutions, (n.d)

4. Discussion

When it comes to duties where technical or communication requirements are clearly specified, the diagnosis of GICs in international cases—particularly those from Germany and the USA—demonstrates good governance. There are several policies pertaining to data handling, and the data flows easily across the various departments. To maintain the system safer and employ defenses against hacking trials, all three GIC cases use the most recent hardware and licensed software versions. The questionnaire method was applied to Egyptian GIC managers in order to determine the difference between the Egyptian and foreign situations. Only a small number consented to respond without conditions, one agreed to an in-person interview, and only four requested the lengthy process of obtaining official authority approval. However, the largest percentage declined to respond to the questionnaire without providing an explanation (Fig. 6).
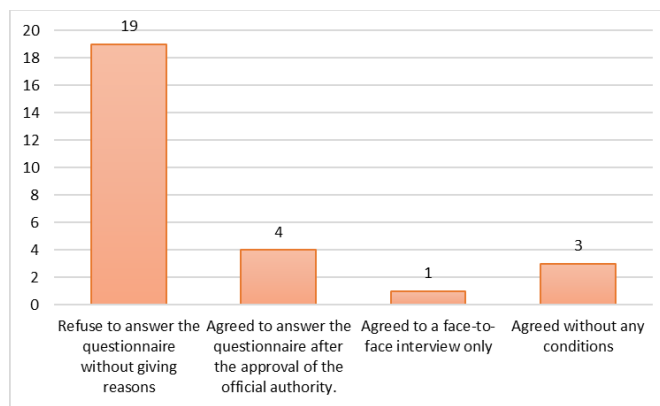

Figure (6): Number of questionnaire responders based on acceptance or rejection status
Source: Authors

Depending on the information analysis received from the questionnaire and in contrast to international GICs, the newly founded Egyptian GICs lack a sound governance structure, have a small workforce with insufficient human resources, use outdated hardware, lack clearly defined tasks, and use cracked software versions. The previous deficiencies represent the gap between the governance of Egyptian and international GICs, and the gap will be closed by proposing a framework to achieve good governance. The framework targets the ideal proposal of GIC departments and organizational structure to guarantee clarity of the administrative structure and no overlap of specializations, in addition to clarifying the personnel, tasks, and responsibilities for each department to ensure the flow of assignments. Regarding the data, which is the cornerstone of the GICs work, the framework illustrates a model for data governance and the different controls for classifying collected data, besides the policies for better data handling and the multi-channels for smooth data establishment and delivery. Regarding the hardware and software, the proposed framework pointed out that the GICs should be supplied with higher versions of workstations, and the software should be licensed from original sources. So, it is expected that the proposed framework will apply intellectual and methodological changes to GICs, leading them to work smoothly (see Table 6).

Table 6. Expected changes to the GICs after implementing the proposed governance framework

Before	After
The central government is responsible for GICs operation.	Each governorate is responsible GICs operation.
Reliance on central government funds and financial resources	Reliance on governorate revenues, stakeholders, and local responders

Woking to achieve the governate's plan	Working for achieving the plans of the governorate and state
Using the reactive approach	The proactive approach involves taking operations as precautions to conserve natural resources and keep away from areas of disaster
Focusing on urban planning	Focusing on urban and economic development
Post-event planning activities	Pre-event planning activities
No clear administrative structure	Clear administrative structure with clear definition of tasks
No specific data policies	Find out the proper policies to deal with the data to keep it safe and update
No horizontal or vertical integration	Creating horizontal or vertical linkages to achieve full integration with departments inside or directorates outside

Source: Authors

5. Recommendation for better framework implementation

- Building a database of workers, trainees, and those ready to work in the field of GISs,
- Continuous training for GIC staff to improve their skills,
- Continuous development of mechanisms for collecting spatial data and qualifying it to achieve maximum benefit from continuous database planning to fill current gaps and weaknesses,
- Periodic evaluation of all devices and systems used,
- Do not allow the use of undesignated programs and applications, which makes them vulnerable to hacking,
- Announcing the services provided by GIC to citizens to achieve financial returns that can develop its infrastructure.
- Creating a field of competitiveness among the GIC personnel through monetary and moral incentives to ensure continued quality of work

Abbreviations

"OECD" Organisation for Economic Co-operation and Development, "IFC" The International Finance Organisation, "GNSS" global navigation satellite system, "SDA" Sustainable Development Planning, "GISs" Geographic Information Systems, "GICs" Geospatial Information Centres, "SDI" Spatial Data Infrastructure, "NSDI" National Strategic Defence Initiative.

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