

# State-of-Play towards Building Turkey GDI

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**Key words:** GIS, Geo-Data Infrastructure, SDI, GDI, Turkey

## SUMMARY

A variety of Geographic Information Systems (GIS) projects have been fashioned by different public institutions in Turkey. But, a fit coordination process has not been provided among these public institutions that produce and use geo-data. Technical, standard, and policy deficiencies result in time and effort losses on data production, management, and sharing. Demands for high-qualified, up-to-date, and interoperable geo-data have increased with impetus for managing disaster events, domestic security, environmental degradation, urban areas, and community preparedness as a nation. However, the lack of up-to-date cross border geo-information hampers cooperation among local governments and decision making at other levels. The focus is now increasingly shifting to the challenges associated with integrating these systems into a society perspective with Geo-Data Infrastructure (GDI) concept. In this study, the potential of public institutions that work with geo-data was examined before building GDI in Turkey. At national level, current GIS projects were determined and reviewed with Information Infrastructure (II) approach. At province level, a field work was executed to the public institutions that produce and use geo-data. The results of the field work were evaluated with the SWOT analysis and matrixes. In this way, applicability of GDI was determined with quantitative assessment as a case study through province to national level in Turkey.

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## 1. INTRODUCTION

Geo-information related to the earth started to be used on various application areas such as environmental management, urban planning, disaster management, demographic application, and so on, besides finding a way or location. Using geo-information effectively has become a critical topic to direct social, economic, and policy issues. Geo-Information Systems (GIS) can support decision making processes on various working communities. After Information and Communication Technologies (ICTs) have developed and requirements increased for using geo-data corporately, Geospatial/Spatial Data Infrastructure (GDI) concept appeared. GDI enables to access, manage, and share geo-data effectively with standard, policy, and technology components. Many countries are concerning to build a national GDI at different administrative levels, from local to international level.

In Turkey, Digital Maps started to be produced after 1990s. The General Command of Mapping (abbreviated as HGK in Turkish) pioneered digital map production especially. Standard Topographic Maps (STMs), smaller than 1:5000, are produced by HGK. Large Scaled Maps, 1/5000 and larger, are produced by Land Registry & Cadastre Directorate (abbreviated as TKGM in Turkish) and State Provincial Bank. These maps are used as base map by public institutions, but the maps have not been qualified for various thematic applications of public institutions. Other public institutions and municipalities also produce maps serving their own needs. Turkey has speeded up her efforts to transform into an information society with "e-Transformation Turkey" project as of 2003. This triggered actions for building "Turkey National GIS" under the responsibility of TKGM. With Action-47, current situation to build GDI was examined in 2004. With Action-36, Turkey National SDI strategy as policy encouragement was determined in 2005. KYM-75 action, embarked on 2007, aims to build a portal where public institutions can present their geo-information (DPT, 2007). According to Turkey State Planning Organization (abbreviated as DPT in Turkish) (2004), coordination has not been provided among public institutions that produce and use spatial data. Technical, Standard, and policy deficiencies result in time and effort losses on data production, management, and sharing. Public Institutions produce spatial data, depending on their responsibilities and rights legalized by the laws.

In this study, the potential of public institutions that work with geo-data was examined before building GDI in Turkey. At the national level, current GIS projects were determined and reviewed with Information Infrastructure (II) approach. At the province level, a field work was executed to the public institutions that produce and use geo-data. The results have been evaluated with the SWOT analysis and matrixes. In this way, applicability of GDI was determined with quantitative assessment as a case study through province to national level of Turkey.

## 2. INFORMATION INFRASTRUCTURE APPROACH FOR SDI EVALUATION

II provides integrated solutions with the helping of ICTs and are described with technologies, networks, standards to support various application areas over time and space. GDI can be accepted as a special case of II beyond GIS and facilitates integration without duplication. II approach can provide useful insights to examine technical and institutional complexities within GDI. The rainbow metaphor includes a socio-technical architecture and a seven-layer conceptual model of access to II. In developing countries, the predominantly techno-centric thinking around GDIs continues to significantly slow down the progress of the implementation efforts. However, socio-technical issues should be examined for a complete GDI perspective (Georgiadou, 2003).

The seven sections of the rainbow metaphor include carriage, devices, software, content, service/access, literacy, governance as explained below (Aydinoglu and Yomralioglu, 2006);

1. Governance: The way decisions are being made to develop and operate the infrastructure.
2. Literacy: The skills that citizens need to take full advantage of everything mentioned before.
3. Service/Access: Mechanisms that provide relevant information to citizens for their interaction, including data use and sharing.
4. Content/Data: The geo-information content that the users produce and use.
5. Software: Software that runs the devices and makes the connection to services. The use of free, open source, and customized software in GDI/II domains
6. Devices: Affordable ICT devices that people operate to access information.
7. Carriage: Facilities to access and share information and telecommunication infrastructure, related policies to encourage e-government.

Survey questions of the field work were arranged and categorized in view of rainbow sections. This survey includes 35 questions and 2 tables. A field work was carried out to examine not only technical and content but also social view of SDI Development of Turkey. At national level, some current projects were examined in view of Rainbow sections. At province level, the field work with this survey was carried out to public institutions.

## 3. NATIONAL GIS ACTIVITIES of TURKEY

All public institutions concerning geo-data were determined and grouped hierarchically at Government, National, Regional, Provincial, and Local level. 13 ministries including Ministry of Environment and Forestry (abbreviated as COM in Turkish), Ministry of Public Works and Settlement, Ministry of Agriculture, and Ministry of Energy and Natural Resources primarily deal with works relating to geo-information intensely. National level contains 29 public institutions, as a general directorate, which conduct mapping and GIS projects. Especially, HGK is the national mapping agency responsible for building topographic database by producing official STMs of entire country in both hard copy and digital formats. Regional Directorates, Regional Directorate of Forestry and State Hydraulic Works (DSI) particularly, need geo-data in their thematic projects. Table 1 evaluates current situation with rainbow sections at national level (Aydinoglu, et al., 2008).

**Table 1. A general evaluation of National GIS activities of Turkey**

<b>Governance</b>	<ul style="list-style-type: none"> <li>• TKGM as a major producer of geo-information manages National GIS actions.</li> <li>• With Action-36, Turkey National GIS concept and implementation models were determined in 2005. But, a legal framework has not been initiated for GDI development yet</li> <li>• KYM-75 action aims to build Geo-Portal after determining geo-data standards.</li> <li>• There is no centrally management authority or coordination body among institutions as a mediator to built GDI in Turkey. Inter-ministerial Committee (abbreviated as BHIKPK in Turkish) is responsible for map related production processes in all country.</li> <li>• Regulations for distributing, distributing, pricing, and managing geo-data have not been determined and put into practice yet.</li> <li>• According to Zoning Law revised in 2009, The Ministry of Public Works and Settlement has tasks for building, developing, and processing GIS in Turkey</li> <li>• According to 5216 numbered Municipality Law and 5272 numbered Metropolitan Municipality Law, municipalities are compulsory to build GIS and Urban GIS.</li> <li>• Access to Public Sector Information accepted in 2003, Public Institutions are responsible for presenting all kinds of information and documents.</li> <li>• Interoperability Circular published by prime ministry of Turkey constitutes standards to build information systems in all central and local public institutions.</li> </ul>
<b>Literacy</b>	<ul style="list-style-type: none"> <li>• General Directorate of Public Institutions has more eligible and well-educated personnel.</li> <li>• Data sharing is not at expected level because of security considerations and poorly understood technical issues.</li> <li>• Municipalities, Cadastre, Environment/Forestry, Highway, and Water Directorates have personnel to manage geo-data and GIS applications. But, Agriculture, Health, Education, and Electricity Directorates generally do not have employers to manage GIS applications.</li> <li>• All institutions have ICT sections, but most of them generally do not have employees for GDI</li> <li>• The importance of GDI has not perceived by employers yet.</li> </ul>
<b>Service/Access</b>	<ul style="list-style-type: none"> <li>• Data are provided either on CD or paper. In Intra-Institutions, local network provides an effective method to exchange spatial data.</li> <li>• There are not any on-line services to download core geo-datasets that contribute the national SDI initiative.</li> <li>• There are web mapping services available for geo-data including; <ul style="list-style-type: none"> <li>- Geographic Names Database by GCM</li> <li>- Digital Turkey Databases by GCM</li> <li>- Soil and National Agriculture Information System by Ministry of Agriculture</li> <li>- HBB- Map Information Bank Metadata Query by TKGM</li> <li>- TAKBIS- Land Registry and Cadastre Information System by TKGM</li> <li>- CORINE Land Cover/ Forest/ Environment/ Water Information System by COM, and</li> <li>- Especially metropolitan municipalities have web based mapping applications.</li> </ul> </li> <li>• GCM website provides description about their maps and digital products, but online dissemination is not possible.</li> <li>• Some e-government and internet GIS services for citizens were produced for agriculture, transportation, and other thematic sectors to present the maps.</li> <li>• Almost all provinces and municipalities browsed the information on internet. Some web services were browsed, such as Web Urban Atlas, Zoning Plan, etc.</li> <li>• Most municipalities in especially big provinces are trying to build Urban GIS applications. According to a survey executed to 3066 out of 3228 municipalities of Turkey (TUIK, 2005), 18 % (543) of the municipalities have numbering unit and 4 % (126) of which work on Urban GIS.</li> </ul>

**Table 1 (continued). A general assessment of National GIS activities of Turkey**

<b>Content</b>	<ul style="list-style-type: none"> <li>• The geodetic reference system and projection systems are standardized with TUTGA (Turkey National Base GPS Network) based on ITRF-96 (International Terrestrial Reference System) and GRS-80 (Geodetic Reference System-1980).</li> <li>• UVDF-National Data Change Format determines data types and data flows, based on XML format. But, it was discussed that UVDF should be updated for national GIS development and compliant with GML 3.X.</li> <li>• Geo-Data Standards have not been determined yet.</li> <li>• According to Action-36, names of reference data themes were determined.</li> <li>• There is no metadata standard among public institutions. HGK has their metadata standard. And, metadata standard has been determined in HBB project.</li> <li>• Public institutions produce spatial data, depending on their needs.</li> <li>• Institutional responsibilities have not been determined and geo-data was produced repeatedly.</li> <li>• Examining GCM STM Data Dictionary, Feature classes are not defined with attributes and relationships for using in GIS applications.</li> <li>• Besides national data catalog of STMs produced by HGK, large scaled maps are produced, depending on Large Scaled Map Production Regulation (BÖHHBU). BÖHHBU was revised and enclosed with feature / attribute catalog in 2006. But, this catalog was not designed to solve application-driven geo-information user needs.</li> <li>• GIS applications of local governments were developed, depending on GIS software and related companies. Therefore, geo-data is not interoperable.</li> <li>• Interior Ministry is in process to combine the databases of National Address Database (UAVT) and National Citizenship System (MERNIS). Local Governments can combine these data on their own Urban GIS applications.</li> </ul>
<b>Software</b>	<ul style="list-style-type: none"> <li>• Microsoft architecture is very common in Turkey as operation system.</li> <li>• In addition to Microsoft SQL Server, Oracle is the most common DBMS.</li> <li>• Institutions use different kinds of GIS software. National software NetCAD is very popular because it produces acceptable interfaces in Turkish legally.</li> <li>• There are no accepted international or de-facto standards in public institutions. Public Institutions generally use institutional standards in intra-organizations.</li> <li>• Most institutions do not have database and image processing software.</li> </ul>
<b>Devices</b>	<ul style="list-style-type: none"> <li>• All public institutions have hardware capacity to use and analyze geo-data</li> <li>• Almost all public institutions have Windows based platform.</li> <li>• Almost all institutions published their web page on web servers situated in General Directorates or any service provider.</li> <li>• Data Servers enable to manage the data in especially General Directorates of these institutions.</li> <li>• Especially Metropolitan Municipalities have possibilities to manage and share geo-data on Web /Data Servers.</li> </ul>
<b>Carriage</b>	<ul style="list-style-type: none"> <li>• Telecommunication Law has been recognized to renovate old laws.</li> <li>• Electronic Signature Law certified by Telecommunication Authority legalizes electronic signatures.</li> <li>• Other laws; personal data, consumer, security law, and like this are in progress.</li> <li>• ADSL users started to increase enormously but not at expected level. 3G technology was embarked in 2009.</li> <li>• Intranet and internet access is at very well to use and share geo-data in intra-public institutions.</li> </ul>

#### 4. EXAMINING PROVINCIAL GDI DEVELOPMENT of TURKEY

Provincial System is the main administrative unit of Turkey. If GDI is modeled for a province (called as “il” in Turkish), it can be a model from local to national level for 81 of provinces of Turkey. The field work was executed on 37 of public institutions of Trabzon province that produce and use geo-data as seen on Table 2.

**Table 2. Public institutions that produce/use geo-data at provincial level**

#	Public Institutions	Level	A1	A2	B1	B2	C	D	E
1	GOVERNORSHIP	3							
2	PROVINCIAL PUBLIC MANAGEMENT	3							
3	MUNICIPALITY	3/4							
4	Provincial Dir. Of Agriculture	3							
5	Provincial Dir. Of National Education	3							
6	TEDAS-Provincial Dir.of Electricity Distr..	3							
7	TEIAS-Turkey Electricity Transmission Comp	2							
8	DSİ-Regional Dir. of State Hydraulic Works	2							
9	Regional Dir. Of Transportation	2							
10	TCDD-Turkey Regional Head Dir.of Railways	2							
11	DLH-Regional Dir. of State Ports&Airports	2							
12	BOTAS-Pipelines&Petroleum Transp.Comp.								
13	PTT-Provincial Dir. Of Post	3							
14	Provincial Dir. of Telecom	3							
15	Provincial Dir. of Public Works & Settlement	3							
16	Regional Dir. of Highways	2							
17	Provinc.Dir. of Land Registry and Cadastre	2							
18	Dir. of Land Registry	4							
19	Dir. of Cadastre	3/4							
20	Regional Dir. of Provinces Bank	2							
21	Provincial Dir. of Health	3							
22	Regional Dir. of Turkey Statistics Institute	2							
23	Regional Dir. of Forestry	2							
24	Dir. Of Forestry Management	3							
25	Provinc.Dir. of Environment and Forestry	3							
26	Regional Dir. of Meteorology	2							
27	Council for Culture and Natural Ent.Preserv	2							
28	Provincial Dir. of Culture and Tourism	3							
29	MTA-Reg.Dir.of Mineral Res.&Exploration	2							
30	Provincial Dir. of Industry and Trade	3							
31	Provincial Dir. of Security	3							
32	Province Gendarme Command	3							
33	Group Command of Coast Security	2							
34	Provincial Dir. Of Youth and Sport	3							
35	Provincial Mufti. of Religion	3							
36	Directorate of Navigation and Hydrography	1							
37	Undersecretariat of Marine	1							

**A1:** Geo-data Provider  
**A2:** Data Provider  
**B1:** Direct User  
**B2:** User  
**C :** Developer  
**D :** Legal  
**E :** Decision Maker

The Field Work, a survey based on rainbow metaphor, was carried out with meetings which were applied to data providers (A1 and A2) in Trabzon province of Turkey. In addition; web pages, projects, and research reports of these public institutions were used to examine state-of-play of a province towards building GDI. The results of the field work were evaluated with two methods; SWOT Analysis and Boston Matrixes.

#### 4.1. SWOT Analysis

SWOT refers to concepts; S (*Strengths*), W (*Weakness*), O (*Opportunities*) and T (*Threads*). SWOT analysis determines strength and weakness of public institutions to build GDI, examines opportunities and threats caused by external environment. Table 3 combines SWOT analysis results of public institutions for Trabzon province. In this way, the potential on geo-data management was evaluated at province level in view of socio-technological GDI development.

#### 4.2. Boston Matrix

Boston Matrix evaluates geo-data potential of public institutions quantitatively. SDI evaluation criteria that is based on works in a multi-view framework to assess GDI (Crompvoets, et al., 2008) and are used to evaluate GDI development potential in view of “Interest-Power” and “GIS-technology- Geo-data needs”. “Interest” defines interest on geo-data sharing while “Power” defines public institutions’ influence on GDI development. While “GIS-technology” evaluates carriage, device, and software potential, “Geo-data Needs” determines needs on geo-data applications of public institutions. Half points for each evaluation criteria divides matrixes into four different levels for GDI development as seen on Figure 1 and 2.

Interest/Power: As seen on Figure 1, 12 out of 23 public institutions have High Power while 9 out of 23 public institutions have High Interest.

- High Interest-High Power: 5 of public institutions are in this category, including Provincial Public Administration (2), Municipalities (3), Regional Directorate of State Hydraulic Works (8), Provincial Directorate of Public Works and Settlement (15), and Directorates of Cadastre (19). These public institutions have sufficient technology and often use geo-data. Evaluation results pointed out that these institutions should be actors of GDI development.
- High Interest- Low Power: 4 of public institutions are in this category. These public institutions often use geo-data, but depend on sharing geo-data with other institutions.
- Low Interest- High Power: 8 of public institutions are in this category. These public institutions have sufficient technology and sources for GDI development, but are not aware of geo-data sharing needs.
- Low Interest- Low Power: 6 of public institutions are in this category.

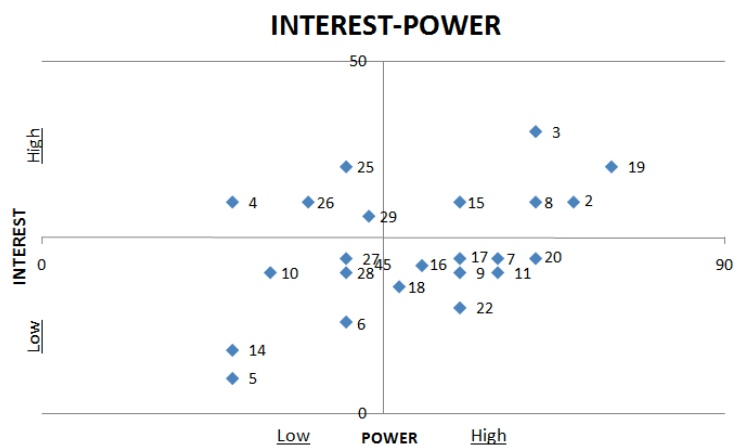


Figure 1. Interest-Power Matrix





S	Governance	Literacy	Service/Access	Data/Content	Software	Device	Carriage
STRENGTH	<p>* Municipalities and Cadastre Directorates have payment policy for "Data Recovery".</p> <p>Protocols were signed for data exchange between public institutions.</p> <p>* TLJK defined policy and payment procedure for exchange of statistical data.</p>	<p>* Municipality, Cadastre Environment and Forestry, Highways, Hydraulics Works, and etc have sufficient personnel to manage GIS projects.</p>	<p>* Most public institutions built their web sites. Especially, municipalities and urban atlas, numbering and similar applications with web mapping technology.</p> <p>* A lot of institutions generally share geo-data on paper maps.</p> <p>* Electricity, Agriculture, Health, Education, and etc have centralized data management system.</p>	<p>* Municipalities, zoning plan services, Cadastre etc use intra-institutional standards according to law and manage geo-data digitally.</p> <p>* A lot of public institutions have data exchange problem both intra-institutions and between public institutions.</p>	<p>* NetCAD as a national software are used on most of public institutions, but these programs are not at expected level for GIS functionalities.</p> <p>* Data including statistics, electricity, etc are managed on centralized data servers.</p>	<p>* Almost all public institutions have computer capacity to process geo-data.</p> <p>* Planning and investment should be done to build data server on public institutions of COM.</p>	<p>* Almost all institutions have internet access, mostly ADSL.</p>
WEAKNESS	<p>* Data exchange is possible inside public institutions. But, policy for data exchange and pricing is unclear between public institutions.</p>	<p>* Institutions has ICT departments, but do not have potential for configuring GDI servers and networks.</p> <p>* Agriculture, Health, Education, Electricity, and etc do not have sufficient personnel.</p> <p>* Although Provincial Public Administration has a variety of tasks relating to geo-data, they do not have sufficient GIS</p> <p>* Personnel in almost all public institutions have not perceived the requirement of GDI development.</p>	<p>* Bureocracy and legal procedure effect geo-data management negatively.</p>	<p>* Most institutions archive geo-data on analog format.</p> <p>* Most institutions do not have geo-data and metadata standards.</p> <p>* It is generally difficult to manage geo-data digitally in public institutions.</p>	<p>* Public institutions generally do not have database software.</p> <p>* Public institutions generally do not have image processing software.</p>	<p>* Most of institutions do not have data/ internet servers to process geo-data.</p>	<p>* Internet bandwidth do not enable to manage geo-data effectively on networked environment</p>
OPPORTUNITIES							<p>* National GIS actions can trigger GDI development at local level. *With TAKBIS project, TKGM configured centralized data and web servers share cadastral data.</p> <p>* Ministry of Agriculture and COM have internet GIS applications to local governments contribute GDI development at local level.</p>
THREADS							<p>* No administrative authority to manage GDI development</p> <p>* It is not determined which institution produces which data.</p> <p>* No law and regulation for geo-data sharing</p> <p>* No geo-data and metadata standard</p>

Table 3. SWOT analysis results

**Technology/Geo-information needs:** As seen on Figure 2, 9 out of 23 public institutions have High GIS Technology while 9 out of 23 public institutions have High Geo-information needs.

- High GIS Technology/ High Geo-information needs: 5 of public institutions are in this category, including Municipalities (3), Regional Directorate of State Hydraulic Works (8), Provincial Directorate of Public Works and Settlement (15), Regional Directorate of Highways (16), and Provincial Directorate of Environment and Forestry (25). There is no risk and institutions have potential to become a market leader. They can get a key role on geo-data sharing.
- Low GIS Technology/ High Geo-information needs: 5 of public institutions are in this category. These institutions are the main geo-data users, but do not have sufficient technology capacity.
- High GIS Technology/ Low Geo-information needs: 4 of public institutions are in this category. Although these public institutions invest GIS technology, geo-data needs of these are at low level.
- Low GIS Technology/ Low Geo-information needs: 9 of public institutions are in this category. These institutions do not need geo-data and depend on geo-data for their works.

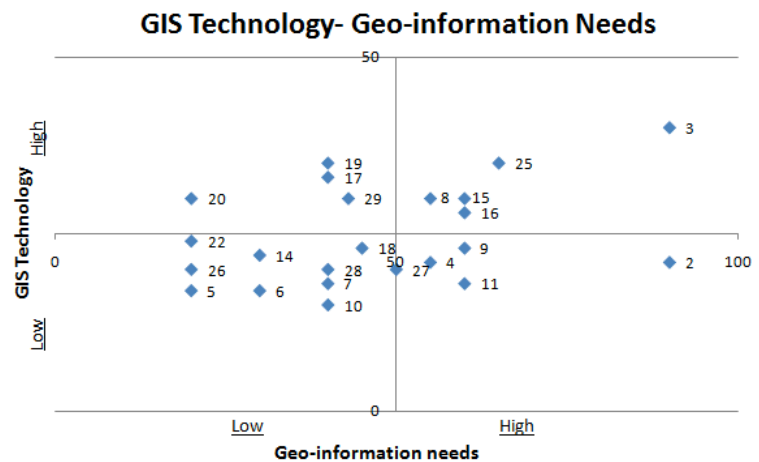


Figure 2. GIS Technology- Geo-information need matrix

## 5. CONCLUSION

The potential of public institutions that work with geo-data was examined in order to build a GDI in Turkey. First, some of the applied GIS projects were determined and reviewed with Information Infrastructure approach at the national level. A field work was also executed to the public institutions that produce and use geo-data at the province level. The results have been evaluated with the SWOT analysis and matrixes. With the SWOT analysis while determining the strength and weakness of public institutions, the opportunities and threats caused by external environment have been examined in Trabzon province of Turkey. In addition, the Boston Matrix also used to evaluate geo-data potential of public institutions quantitatively. Based on these evaluations, it can be said that municipalities, cadastral based administrative units, and environmental related project have been significantly involved in GIS projects in Turkey. GIS technology is also highly available. But still there is a great lack of an umbrella institution that can be responsible to coordinate the national spatial data infrastructure procedures. The geo-data using policy is missing. Therefore data exchanging between public units is an issue while it is possible inside the institutions.

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