

# **The effects of Technological Developments to the Spatial Data Production Costs in the General Directorate of Land Registry and Cadastre (TKGM)**

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**Key words:** Data collection, cost-effectiveness, reporting, decision making, strategic importance, spatial data management

## **SUMMARY**

Information and technology in today's world of rapid development, has become an integral part of our lives, cannot be ignored in this direction has become increasing needs and demands. This is very difficult to respond quickly to problems brought about by the trend. Technological developments and to adapt to keep information current at the time, is very important in order to meet the needs of consumers.

The General Directorate of Land Registry and Cadastre (TKGM) which is the leader in the field of cartography largely continues its missions which are; to keep and update land registry and cadastre system of the country under the responsibility of the treasure, to perform transactions related to real estate and to establish Turkish national spatial information system. TKGM a public agency, has completed many projects. Such as; Continuously Operating GPS Reference Stations (TUSAGA-Aktif), Geo-Metadata Portal (HBB), Orthophoto-Base Map Production and web services, Completion of Initial Cadastre, Cadastral Renovation Project (TKMP), Land Registry and Cadastre Information System (TAKBIS), Turkish National Spatial Data Infrastructure Project (TNSDI), Ottoman Land Registry Archive Information System (TARBIS). TKGM provides updated map and map information to not only public institutions but also to related society in the name of social responsibility principals.

Spatial data management and production costs are quite high compared to the present developments are examined in the light if we should not be difficult to guess. Of any business, without disclosing the costs have been unable to sustainability as an effective management failed to. The effects of Technological Developments to the Spatial Data Production and reflection to social life and data production cost are indicated in this paper by comparing 2003-2004 Marmara Earthquake Emergency Reconstruction Project (MEER) base map production and 2008-2011 Mapping Department (HDB) different base mapping projects values.

**Anahtar Kelimeler:** Bilgi toplama, maliyet-etkinlik, raporlama, karar verme, stratejik önem, mekansal veri yönetimi

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TS number: -Session title: - Paper no: 5793

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# TAPU VE KADASTRO GENEL MÜDÜRLÜĞÜ'NDE (TKGM) TEKNOLOJİK GELİŞMELERİN MEKANSAL VERİ ÜRETİM MALİYETLERİNE ETKİLERİ

Bilgi ve teknolojinin günümüz dünyasında hızla geliştiği, hayatımızın ayrılmaz bir parçası haline geldiği, bu doğrultuda ihtiyaç ve isteklerin arttığı göz ardı edilemez bir hal almıştır. Bu hızlı trendin beraberinde getirdiği sorunlara cevap verebilmek hayli zorlaşmıştır. Bilgileri güncel tutabilmek ve teknolojik gelişmelere anında uyum sağlamak, tüketicilerin ihtiyaçlarına cevap verebilmek için oldukça önemlidir.

Haritacılık alanında Türkiye'de lider durumda olan, Tapu ve Kadastro Genel Müdürlüğü (TKGM) bu misyonu büyük ölçüde devam ettirmektedir. Bir kamu kurumu olan TKGM birçok projeye imza atmıştır. TKGM liderliğinde devam eden Harita Bilgi Bankası (HBB), Türkiye Ulusal Sabit GPS Ağı (TUSAGA-Aktif), Türkiye Ulusal Coğrafi Bilgiler Sistemi (TUCBS) ve Tapu ve Kadastro Modernizasyon Projesi (TKMP)-Ortofoto projeleri bulunmaktadır. Dünya Bankası destekli Marmara Deprem Bölgesi Acil Yeniden Yapılandırma Projesi(MEER) ve Tarım Reformu Uygulama Projesi(ARIP) ise tamamlanmıştır. Haritacılık alanında lider konumda olan TKGM bu projelere harita ve harita bilgileri anlamında üretilen veri temin etmekle birlikte sadece kamu kurumlarına değil sosyal sorumluluk ilkesi gereği Türkiye genelindeki her talebe yönelik güncel verileri sunmaktadır.

Mekansal veri üretiminin yönetimi ve günümüze kadar gelen gelişmeler ışığında değerlendirecek olursak maliyetlerin hayli yüksek olduğunu tahmin etmek güç olmasa gerek. Hiçbir işletme, maliyetlerini ortaya koymadan etkili bir yönetim ortaya koyamadığı gibi sürdürülebilirliğini de sağlayamamıştır. Ayrıca her işletmenin sosyal hayata katkılarının olduğu gerçeğini de göz önünde bulundurduğumuzda önemi bir kat daha artmaktadır. TKGM bünyesinde mekansal veri üretim tekniklerimizin maliyetlerindeki gelişmeleri görebilmek için 2003-2004 yılları MEER projesi harita üretim maliyetleri ile Harita Dairesi Başkanlığı (HDB) 2008-2011 yılları arasındaki harita üretim maliyetleri ve sosyal hayata katkıları dikkate alınmıştır. İşte buradan hareketle teknolojik gelişmelerin mekansal veri üretim maliyetlerine etkilerini ortaya koyabilmek, bu verilerin yönetimi anlamında teknolojinin maliyetler üzerinde etkin rol aldığı stratejik önemini ve sosyal hayata katkılarını ortaya koyabilmek adına yapılmış bir çalışmadır.

## 1. INTRODUCTION

On August 17, 1999 an earthquake measuring 7.4 on the Richter scale at 3:00 am. devastated the Marmara region of Turkey. Over 15,000 lives have been lost and there is extensive damage to Turkey's industrial heartland. As the region digs out of the rubble, it is clear that a major reconstruction effort and recovery plan is needed. International support for Turkey for the immediate relief effort has been rapid and generous. As Turkey looks ahead to rehabilitation and reconstruction, substantial international financing is needed. This preliminary assessment outlines the likely impact of the earthquake on the economy and the

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cost of reconstruction and recovery. It also highlights the key issues that need to be addressed to reduce the costs of future natural disasters in the country.

This earthquake was a milestone for not only TKGM but also for other institutions. Most of them started disaster infrastructure related application. Like Directorate General of Building Affairs (DGBA) for implementation of construction of temporary and permanent houses, like Directorate General of Disaster Affairs (DGDA) for investigation, research, damage assessment, selection of place, map, plan implementation, expropriation, allocation, detection of beneficiaries, temporary housing and like Directorate General of Technical Research and Implementation (TRI) at center for drawing up and implementation of building development and land use plan and others. All this kind of application appears wide span area by improving year by year depend on used latest technologies.

TKGM has very important role in property related application. TKGM should deliver updated cadastre, property information and base map for other institutions. TKGM has many projects from starting Marmara Earthquake disaster up to day. Base mapping project cost changes are presented in this paper under the used technologies.

## **2. DIFFERENT BASE MAPPING PROJECTS**

### **2.1 Marmara Earthquake Emergency Reconstruction (MEER) Project**

MEER project specific objectives, were to build a sustainable emergency management response system as a way to reduce the future impact of earthquakes on the country, by establishing a competent emergency management agency, a disaster insurance scheme and improving land use management and enforcement of building codes and to re-establish normal living conditions in the areas hit by the earthquake by supporting a trauma program for adults and reconstructing new houses.

The following are the components originally envisaged under the project:

#### **Component A - Disaster Response System and Risk Mitigation**

- A1: Emergency Management and Response System.
- A2: Disaster Insurance Scheme.
- A3: Land Use Planning and Enforcement of Construction Codes.
- A4: Cadastre Renovation and Land Management.

#### **Component B - Trauma Program for Adults.**

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Component C - Construction of Permanent Housing in Bolu, Kocaeli and Yalova.

Component D - Project Management.

The primary objective of subcomponent (A4) were to establish a land information system to support the reconstruction and development of the Marmara region. In particular, the sub-component was to support activities to: (i) supply current and reliable land ownership information to cope with the post-earthquake situation, and update and improve the obsolete registers and maps; (ii) facilitate land supply operations, with emphasis on housing schemes and the overall improvement of the land market.

Within the scope of the project, new earthquake resistant buildings were constructed for the Land Registry and Cadastre Directorates in the region, works related to densification of TNBGN (Turkish National Basic GPS Network) in the region were completed, electronic equipment and GPS systems were procured, cadastral renovation works completed for 93 villages and first cadastral plans were developed for 101 villages. Total cost was 24.44 USD millions.

A4-Cadastre Renovation and Land Management subcomponent of MEER Project was the core application due to do A1: Emergency Management and Response System, A.2: Disaster Insurance Scheme, Land Use Planning and Enforcement of Construction Codes and Component C - Construction of Permanent Housing in Bolu, Kocaeli and Yalova.

TKGM used classical photogrammetric method in this area for the base mapping to renovate cadastre. After densification networks which is two base length around the blocks and additionally in every mapsheet two signalized cadastral point used for data transformation. For photography analog camera used. Other works done by classical photogrammetric way.

## **2.2 Agricultural Reform Implementation Project- ARIP**

The objectives were improving economic efficiency/productivity in the sector, protecting farmers to some extent from income losses due to reform measures and finally fiscal stabilization. The Project components were:

**Component A**, Direct Income Support. This supported the Ministry of Agriculture and Rural Affairs (MARA) to create the National Registry of Farmers (NRF) throughout Turkey, and the General Directorate of Land Registry and Cadastre (TKGM) to try to accelerate completion of the Turkish cadastre (on which the NRF was largely based) through provision of computers, software, and labor services (canvassers, surveyors, etc.). The main areas of focus were the poorer and more remote provinces of eastern Turkey, where land registration activities had always lagged.

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**Component B**, Farmer Transition. This was intended to physically reduce areas of two crops in perennial oversupply, primarily hazelnuts and to a much smaller degree, tobacco.

**Component C**, Agricultural Sales Cooperatives and Unions Restructuring.

**Component D**, Project Support Services. Aside from the normal project management and fiduciary functions, this component was intended to finance information campaigns to explain to the farm community why subsidies needed to be cut, how to apply for DIS payments, and related topics.

**Expansion of Land Registration activities under Component A.** From the beginning, a relatively small sum (about \$12.7 million) was earmarked to indirectly support the completion of the Turkish cadastre, by providing equipment and software to TKGM to complete the computerization of existing land records in 19 eastern provinces (of 81 in Turkey). These funds were never used. In the restructuring process over \$50 million was allocated to the full range of registration and cadastre survey services and equipment (as well as required aerial photography, geodetic control and base mapping), to directly complete the registration process in over 2,500 villages in the less developed regions of Turkey. This was seen as both instrumental to the rapid completion of the NRF, and also as a significant good in its own right, bringing security of tenure to a region where this was uncommon. This restructured subcomponent proceeded so well that it was later formally expanded to over \$100 million worth of work, one of the largest focussed land registration and cadastre campaigns ever assisted by the Bank. The aggregate target was to issue first titles to 3.3 million parcels.

Regarding land registration activities, a large part of the targeted areas were included in the cadastre activities and subsequently registered. Although this work was carried out to help the set up of NFRS, it was not achieved to share of registry records via online database between MARA and General Directorate of Land Registry and Cadastre (TKGM).

With ARIP Project TKGM decided to produce orthophoto as a basemap besides vector mapping. Because orthoproduction is very cheap and very fast. And also TKGM decided to use digital aerial camera and purchased a new one. In case of first application of digital camera the point densification not changed around the block as two base length. After getting good results only orthoto mapping production will be goal of TKGM as a official decision.

### **2.3 Land Registry and Cadastre Modernization Project (TKMP)**

Turkey has a long history of protection of property rights. More than 95% of land in Turkey is mapped and registered, and the Turkish Land Registry and Cadastre Agency (TKGM) plans to complete the registration by 2008. Nevertheless, significant improvements are needed to fully modernize the TKGM and bring it to European standards.

The most challenging aspect is that cadastral maps continue to be in a paper format, vary in accuracy and consistency, and are not linked to the national network. This makes it difficult to support E-government applications as cadastre maps serve as a base mapping for many government applications. Furthermore, in many localities maps are out of date and do not correspond with the ground locations and areas, differing sometimes by up to 10 meters. This

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situation resulted from the varying quality of surveying technologies used in the last 100 years and the lack of required resources and regulatory means to keep the cadastre up to date and to be truly representative of the realities on the ground. Over time, several different geographical coordinate systems for the cadastre have been used in Turkey, ranging from graphical systems 100 years ago, then local systems, and finally, in the last 20 years, to a national coordinate system. Coordinates are central to digital spatial information systems, and at present, there is no standard system in use for the country's cadastre. This lack of a consistent coordinate system is a critical shortcoming for both developers, spatial analysts and users, and it will take several years to rectify.

The digital cadastre information provides the base maps and related information for many government functions such as municipal services, emergency management, land use planning and development control, postal services, real estate monitoring, utilities management and property taxation. Most countries in Europe, including many of the transition economies, have moved from paper-based to computer-based land registry and cadastre systems. The success of the Turkish transition to a uniform digital environment will require significant efforts to deal with data renovation and updating, building the IT and communications infrastructure in the TKGM central and field offices, and significant human resources development program to upgrade the skills of TKGM staff to operate effectively in the new environment.

The overall goal of the project is to contribute to government agenda to improve quality and effectiveness of public services through spreading and making effective e-government applications. The specific objective of the proposed project is to improve the effectiveness and efficiency of the land registry and cadastre services. This objective will be achieved through:

- renovating and updating cadastre maps to support digital cadastre and land registry information;
- making the digital land registry and cadastre information available to public and private entities
- improving customer services in land registry and cadastre offices
- improving human resources in the TKGM
- developing policies and capacity to introduce in Turkey best international practices in property valuation.

TKMP Project components are; Component 1: Cadastre and Land Registry Renovations and Updating including base mapping, Component 2: Improved Service Delivery including integration data into e-government applications such as TAKBIS, NSDI, etc., Component 3. Human Resources and Institutional Development, Component 4. Property Valuation, Component 5. Project Management

Within the TKMP Projects all base mapping components is based only orthophoto production using digital aerial camera. Minimum required control points are used. All produced orthophotos are used not only TKGM institutional needs but also for other governmental institutional needs as web services.

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As a seen on table large scale analog vector mapping is very expensive. Orthophoto production using digital aerial camera is very cheap. When analog camera used film development, film scanning, aerial triangulation and etc. is increased mapping cost.

### 3. BASE MAPPING COST COMPARISON

As a comparison of different base mapping projects tender year, used technologies, production type and price has been taken in to account. In all project photo flights are done by TKGM without any cost to support private sector. All production is done private sector starting from MEER projects. All comparison is shown on a table and some graphics.

Project	Area Km2	Photo Flight by TKGM	Control Point Distrubution	Mapping Method
MERLIS-Yalova	218.12	Analog Camera BW	2B+4B+2 CAD.Point Per Mapsheet	Vector
MERLIS-Kocaeli	211.66	Analog Camera BW	2B+4B+2 CAD.Point Per Mapsheet	Vector
MERLIS-Sakarya	210.14	Analog Camera BW	2B+4B+2 CAD.Point Per Mapsheet	Vector
ARIP-Dbakır1	3108	Analog Camera Color	2B+4B	Vector and Orthophoto
ARIP-Dbakır2	3204	Analog Camera Color	2B+4B	Vector and Orthophoto
ARIP-Dbakır3	3378	Analog Camera Color	2B+4B	Vector and Orthophoto
ARIP-Sivas1	3960	Analog Camera Color	2B+4B	Vector and Orthophoto
ARIP-Sivas2	3882	Analog Camera Color	2B+4B	Vector and Orthophoto
TKMP-İzmir1	14604	Digital Camera+GPS/IMU	2B+4B	Orthophoto
TKMP-Adana1	11484	Digital Camera+GPS/IMU	2B+4B	Orthophoto
TKMP-Adana2	10884	Digital Camera+GPS/IMU	Corner and Centre	Orthophoto
TKMP-Antalya	14400	Digital Camera+GPS/IMU	Corner and Centre	Orthophoto
TKMP-Eskişehir	12948	Digital Camera+GPS/IMU	Corner and Centre	Orthophoto
TKMP-Çorum1	13866	Digital Camera+GPS/IMU	Corner and Centre	Orthophoto
TKMP-	14568	Digital	Corner and Centre	Orthophoto

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Elbistan		Camera+GPS/IMU		
TKMP-Samsun	9720	Digital Camera+GPS/IMU	Corner and Centre	Orthophoto
TKMP-Sinop	9300	Digital Camera+GPS/IMU	Corner and Centre	Orthophoto

**Table 1:** Mapping Project brief Information

Project	Area Km2	App.Cost per Km2	Average	Scale	Year
MERLIS-Yalova	218.12	6532	6534	1000	2003
MERLIS-Kocaeli	211.66	6441		1000	2003
MERLIS-Sakarya	210.14	6628		1000	2003
ARIP-Dbakır1	3108	353	271.4	5000	2006
ARIP-Dbakır2	3204	303		5000	2006
ARIP-Dbakır3	3378	267		5000	2006
ARIP-Sivas1	3960	215		5000	2006
ARIP-Sivas2	3882	219		5000	2006
TKMP-İzmir1	14604	65	73.5	5000	2009
TKMP-Adana1	11484	82		5000	2009
TKMP-Adana2	10884	37	35	5000	2010
TKMP-Antalya	14400	30		5000	2010
TKMP-Eskişehir	12948	35		5000	2010
TKMP-Çorum1	13866	38		5000	2010
TKMP-Elbistan	14568	26	29	5000	2011
TKMP-Samsun	9720	30		5000	2011
TKMP-Sinop	9300	31		5000	2011

**Table 2:** Comparisons of mapping by used technologies and years

#### 4. RESULTS

As a results we can say;

- The implementation of the project initiated major work in Turkey on cadastre renovation, records digitization and land registration. These activities have been continued beyond the Marmara region with the Agricultural Reform Implementation

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Project (ARIP) under the same agency, GDLRC, who stressed that the experience gained through the MEER project allowed for the swift progress of activities under the ARIP.

- In the context of the cadastral and land management work, it was a first time in Turkey that the GDLRC contracted out service in cadastre renovation to the private sector. According to the agency, this outsourcing process positively affected supply and quality of these services provided by the private sector.
- TKGM decided to improve human and services quality by using new technologies and by implementing new understanding in developed countries such as web based services and e-government based applications.
- TKGM is a core stakeholder among the others. TKGM produced property related sharable information as a National Spatial Data Information basic levels, such as cadastre, orthophoto, coordinate reference system.
- Today more than fifty different governmental institutions used cadastre, land registry information and orthophoto by web services.
- More than half of Turkey covered with 30 cm ground sample distance orthophoto by collaborating General Command of Mapping. Many governmental or non governmental organization are joining to get orthophoto web services to use in their needs. In the near future also any citizen all over the world can get such services within the concept of NSDI.
- Starting by MEER Project Private sectors in geographic data producer are improved their capacities and qualities. Now they can be able to join any competitions all over the world.

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