THE FIRST CITIES OF THE WORLD IN A BIRD'S-EYE VIEW

Oana POPESCU
CSIII, National Institute for Research and Development in Constructions, Urban Planning and Sustainable Territorial Development "URBAN-INCERC", URBANPROIECT Branch, Department of Territorial Cooperation, Environment and Territory Observation, e-mail: popescu.oana@incd.ro

Jianca ŞTEFAN-GORÎN
ACS, National Institute for Research and Development in Constructions, Urban Planning and Sustainable Territorial Development "URBAN-INCERC", URBANPROIECT Branch, Department of Territorial Cooperation, Environment and Territory Observation, e-mail: jianca.stefan@incd.ro

Abstract. The paper presents an overall view of the first cities of the world which are considered to be the origin of urbanization, as they are reflected in historical bird's-eye views and maps, on one hand, and in aerial views, obtained using modern technologies such as aerial photogrammetry, on the other hand. Historical bird's-eye views of ancient cities, having a more artistic style rather than a technical one and requiring thousands of hours to be created, have been replaced nowadays with aerial photography allowing realistic representations. The paper illustrates several bird's-eye views and maps created between the 16th and 18th centuries by famous engravers in order to picture well-known cities, referring at the same time to modern digital techniques that are used today to map, visualise, analyse and manage remains of ancient cities. The use of new research methods in archaeology, such as aerial photogrammetry, high resolution satellite imagery, UAVs, GIS and GPS techniques combined with classical surface or sub-surface survey tools is being exemplified in the case of 5 cities, origin of urbanization, constituted in the first 4 millenniums BC.

Key words: aerial view, urbanization, cartography, photogrammetry, archaeological survey

1. Introduction

Recent studies showed that in a global world, global cities were born (Chubarov, 2015), reflecting a global urban hierarchy and that urban agglomerations grow nowadays in a sequential pattern (Sheng *et al.*, 2014). But looking back into the history, we should remember that the first large urban settlements were formed in western Asia, in the same place considered to be the birthplace of early human civilisations more than 6,000 years ago (Aruz and Wallenfells, 2003). The rise of urban societies, together with major

developments in human history, was based on new techniques such as irrigation and raised field agriculture and occurred in ancient Mesopotamia (Matthews, 2003). Here, after 3500 BC, villages in the wetlands of southern Iraq grew and became towns, and towns further grew and became **cities**. In fact, the only people in the world to have an urban civilization at that time were the Sumerians. More than that, in the Indus Valley, cities like Harappa or Mohenjo-Darro revealed a very controlled civilization and the rectangular form of these cities (not surrounded by walls, but by massive embankments erected to protect the cities from floods) shows that they were **planned**.

The first communities discovered by archaeologists and labelled as "**cities**" date from the 4th Millennium BC, and are located in Sumer, on the alluvial plain between the Tigris and Euphrates, which corresponds to modern-day Southern Iraq (McClellan and Dorn, 2008). Here, in Mesopotamia, where reading and writing were invented, we find what is considered to be the region of **primary urbanization (**Van De Mieroop, 1997**)**. In cities, the Sumerians lived in crowded houses surrounded by defensive walls, due to threats (the nomads' invasion, floods) and to the joint work they did (channels maintenance, dams rising, and irrigation control). The Sumerian cities and temples – such as their famous ziggurats – were built from sun-dried bricks.

A short bird's-eye view of the first cities that developed and flourished between the 4th Millennium BC and the beginning of our era points to several outstanding cities from Mesopotamia, such as Uruk (in the 4th Millennium BC, and considered to be the first planned city of the world), Ur (in the 3rd Millennium BC, one of the primordial cities having an irregular development), or later the Babylon (in the 2nd Millennium BC, considered to be, then, the largest city in the world, laying on more than 100 hectares). Persepolis (in the Persian Empire), one of the most important world heritage archaeological sites in our days, was seen in the first millennium BC as a universal city. In Syria, the city of Al-Rawda was built around 2500 BC in a region that made urbanization impossible, and the city of Damascus is viewed as one of the very few ancient places that knew urban life in the 2nd Millennium BC. The city of Mohenjo-Daro, in the 3rd Millennium BC revealed a planned city in Pakistan and, in ancient Greece, the city of Knossos, considered to be the Europe's most ancient city in the 2nd Millennium BC, was built around a palace, thus known as the "city-palace". Jerusalem, prior to becoming a holy city, was in the 18th century BC a royal city of modest size.

1.1. Beginning of urbanization reflected in maps, cartography, design

Even in the past, "surveying" techniques were employed by the people who were in charge with marking the boundaries of their cities. This happened in Mesopotamia as well, but the Sumerians also used these techniques in order to create plans of their cities.

The first known maps were drawn as plans and were carved in clay tablets by the ancient Babylonians around 2300 B.C. (Woods and Woods, 2011). Also, at the beginning of the 3rd Millennium, people in Egypt created surveying instruments to help them place boundary stones that would mark the fields' borders or the irrigation systems (Headrick, 2009).

Maps are "graphic representations enabling a spatial understanding of

things, concepts, conditions, processes, or events in the human world" (Harly and Woodward, 1987). But a map is not only a document showing a structure on the world, with abstract characteristics, a particular scale on a flat surface in a graphical and photogrammetric way, but it also communicates geographic aspects **in an artistic way**. **Design issues** play an important role in cartography in order to present particular spatial features ("One Picture is worth Ten Thousand Words"). Historic bird's-eye views reflect this affirmation.

1.2. Historical bird's-eye views of the urban landscape

According to the Dictionary (Webster's New World College Dictionary, 2016), the expression "a bird's-eye view" can be used either to describe "a view or a perspective from above or at a distance", or, in a figurative way, to have "an overall, but cursory, view" of a subject. The present research refers to both meanings.

The phrase "bird's-eye view" was used in the history of photographs long before that of "aerial view", terms that are considered to be somehow synonyms today. Being in connection with a panoramic view (took from above and having a perspective), a bird's-eye view is very often used when **producing maps**. Such maps can provide larger views of a certain area, putting emphasis on what is important, and they have an artistic style (they show landscape features in perspective, as well as objects, buildings, people etc.) rather than a technical one (they don't have a scale). Instead of using the horizontal or oblique perspective, as we use today, the maps which were drawn in the past in a bird's-eye view were represented as if they were looking down from the sky, such a bird might see, so that the area was seen from above and at an oblique angle.

The history of such drawings and maps depicting famous cities of the world reveals that some of them required thousands of hours to be created. They usually gave an idealized appearance of the cities they were describing, presenting them in a positive light.

The bird's-eye view maps are interesting and also important, since they can give an idea of the history of regions and cities.

The "city maps" or "city views" that we know today represented in ancient times an artistic science called "chorography", a name that was first used by Ptolemy in its *Geography*, in the second century of our era. At the beginning, this art was used to describe or to map small parts of the world, such as regions or cities.

If in medieval cartography such maps were not very accurate in their proportions, the European Renaissance developed a very precise art of showing bird's-eye views of the urban landscape. Graphic techniques were used to draw city views and the Renaissance artists used the bird's-eye views to represent their cities (such as **Jacopo de'Barbari** in 1500, in a view of Venice). Between 1562 and 1570, the Flemish artist **Anton van den Wyngaerde** (whose artistic value was recently re-discovered) accomplished 62 views of cities and major towns in Spain, which were more realistic and detailed compared to other previous similar works, but still representing an idealized urban space (Cabezos-Bernal and Cisneros-Vivó, 2015). He also contributed with city views for the **George Braun**'s City Atlas, *Civitates Orbis Terrarum*. **Giacomo Lauro**, known for its

illustrations, published in 1641 the *Antiquae urbis splendor*, containing early views of Rome and representing one of the most beautiful works emphasizing its monuments. In its bird's-eye view of ancient Rome, more than 100 places of interest were identified.

Between the 18th and the 19th centuries, the French Architect **Alfred Guesdon**, produced bird's-eye views of several cities from France, Italy, Spain and Switzerland. Used at first for advertising or commercial purposes, these maps have become more precise with the development of modern cartography, in the 19th Century. In that period, each city had its own panoramic map.

1.3. Bird's-eye views and maps of ancient cities, in illustrations

The great city atlas, previously mentioned, *Civitates Orbis Terrarum*, edited by Georg Braun and engraved by Franz Hogenberg, published in six volumes between 1572 and 1617, contained **546 aerial views of urban spaces**, in the form of prospects, bird's-eye views and maps. It was the first collection of city plans and views having a uniform style and presenting the urban life in that period (Nuti, 1994). The plans were accompanied by the history of the cities they illustrated, the atlas being used as a travel guide. Nowadays, the authors re-editing this atlas consider it the "Google Map's ancestor", as it presents "a snapshot of urban life in circa 1600" (Braun and Hogenberg, 1585).

The city of Damascus, which has been inhabited for more than 10.000 years now, **is one of the oldest places to know urban life**. In the 11th century BC, the Aramaic kings made Damascus a city-capital. Although imaginative, the map of Damascus is correctly reflecting the river that flows through the city and is used for irrigations (Fig. 1).

Fig. 1. The oldest map of Damascus: Braun and Hogenberg, *Civitates Orbis Terrarum or Cities of the World,* 1585

Braun's City Atlas also illustrated bird's-eye views of the city of **Jerusalem** as it was in biblical times. But it seems that the most important plan of the city is considered to be (Siew, 2008) the one belonging to Christian van Adrichom, which presents itself under the form of a rectangular map. The author used different sources, such as panoramic views of the city or textual information. Prior to the archaeological discoveries from the XIXth century, this **plan of Jerusalem** was considered to be a correct plan of the city, presenting and describing more than 250 locations. The author is famous for the atlas entitled *Theatrum Terrae Sanctae,* containing 12 maps and plans together with chorographical descriptions, including the Jerusalem town plan.

In terms of urban development, Jerusalem can be considered one of the earliest cities in the world. The ancient fortified town which took shape in the XVIIth century BC was going to become

four centuries later a royal city, of modest size, being under Egyptian control and known as *Urushalim* or *Rushalim*. Archaeologists have encountered difficulties in finding traces of different cities that managed to flourish in places with unfriendly geographical characteristics, which forced the construction of terraces and embankments. Since the 9th Century BC, the town, renamed Jerusalem, grew and progressed from an **urban development** point of view, thus becoming, in the 17th century BC, a regional administrative centre with water adductions and underground water channel. Starting with the 3rd century, the city is seen as a sacred place.

Another ancient city, **Babylon,** was known long before the archaeologists found its remains, being mapped many times throughout history by travellers and explorers. Henry Fletcher (famous engraver of flowers but also known for several city views) created in 1740 a bird's-eye view of the city of Babylon, in which the Euphrates River, flowing in the centre, was surrounded by palaces, sanctuaries and by the famous tower of Babel.

In modern times, bird's-eye views and imaginary representations of the cities were replaced with **aerial photography** and **digital techniques** allowing realistic representation of cities. The results of applying aerial and related techniques in urban planning and archaeology in order to map (Castrianni *et al.*, 2010), explore and describe the ancient sites and landscapes which portray *the first cities in the world and the beginning of urbanization* – are presented below. Aerial photos, together with high resolution satellite imagery or UAV photogrammetry were used to obtain accurate mapping, to preserve or to make reconstructions of cities considered to be the roots of urbanization - such as Uruk, Ur, Babylon, Persepolis, Al Rawda or Knossos.

2. Aerial photographs, an important tool for re-discovering history

2.1. Aerial photography and archaeology

The history of aerial photography records **the first aerial photo** in 1858, taken by the photographer, journalist and caricaturist Tournachon Gaspard Felix, known as Nadar, from a balloon above a neighbourhood in Paris (Verhoeven, 2009).

As a consequence of the development of technology, the language of photography and, subsequently, of aerial photography offers a new conception and perception of history (Cadava, 1997). Applications of aerial photography include, among others, **archaeology**, architecture or property survey (Aber *et al.*, 2002).

Today, exploratory aerial surveys can offer a new image of the past. Airborne archaeologists and landscape planners work together with digital images and photographs, interpreting them and contributing to the protection of archaeological sites and landscapes. Besides field-surveys and excavations, beginning with the '90s, **aerial information** – either from **historical photographs** (as previously described), or **recently from aerial exploration** – offer a better understanding of **the history of our cities**, together with other modern methods and technologies, such as remote sensing.

Ordinarily, the photos are taken according to their purpose: for planning and spatial analysis they are taken vertically, and for outlining distinct features or for perspectives the photos are taken obliquely. Oblique **aerial photographs** are considered to be more suitable in

archaeological research, providing more intuitive and easy-to-read data and information (Ceraudo, 2013).

Archaeology, being a spatial discipline, is deeply dependent on accurate documentation. This is why aerial photography is of great importance to archaeologists (today it is known as "**aerial archaeology**"), acquiring detailed digital aerial images and thus giving an expanded view of the archaeological sites they were studying, in the context of a larger landscape (Verhoeven *et al.,* 2009). Aerial archaeology was born with the first photograph of an archaeological site (Stonehenge) taken from an airplane in 1906 by P.H. Sharpe and it is more and more used nowadays since aerial views allow the discovery of new archaeological sites, being better visible from the air. Aerial survey and air photographs can offer information that is not visible at ground level, being used to discover new sites or to acquire more information about other sites already examined and thus can contribute to a better understanding of ancient settlements. It also represents a unique tool for presenting ancient sites in their topographical environment, by helping to identify a site and assigning the exact location of excavations.

2.2. Modern techniques used to map archaeology

Aerial photography works nowadays with a sophisticated set of tools for acquiring digital imagery, from manned or unmanned vehicles. There are precise methods to map the physical features of a place, such as aerial photography, or satellite imagery and remote sensing **techniques**. The **maps** produced with the help of specialized software such as GIS or CAD incorporate precious spatial information and databases that can be used for distinct goals.

Spatial technology in archaeology is used for visualisation or for spatial data management and analysis. The GIS give the archaeologists the possibility to have 2D or 3D visualisations and to make spatial analyses, and together with remote sensing, digital maps of large areas can be obtained. Using satellite and airborne radar data, new sites can be discovered and landscapes can be surveyed. Through its modelling applications, GIS allows the prediction of the location of archaeological sites. GIS is also a powerful tool in the studies of settlement patterns (McCoy and Ladefoged, 2009). In order to find and map archaeological features, aerial photography is being used (including remotely controlled airborne cameras) together with satellite imagery (Landsat, SPOT, IKONOS, ASTER etc.) or different kind of radars (SIR, SAR, AIRSAR). In order to detect buried architecture it is recommended that multiple methods are used. The LIDAR technology, which was invented in the '60s to study atmospheric composition, since the '70s it began to be used in cartography, and since 2003, along with other technologies, allowed the best possible picture of the soil, passing through vegetation that covered it, being thus used in other disciplines such as spatial planning or archaeology.

Aerial images of sites can also be obtained by using **drones** (Sauerbier and Eisenbeiss, 2010). Although a relatively new technology, the Unmanned Aerial Vehicles (UAVs) are increasingly used to map archaeological sites and to create 3D maps of ancient sites in order to protect them. It is a quicker method than using satellite imagery and GPS data. By offering a detailed aerial perspective, drones give a new spatial perspective. Using UAVs with thermal cameras, which detects infrared light (the heat), it

is possible to see buried parts of a site, which is covered by vegetation or soil, without digging.

In comparison to traditional forms of aerial imaging, drones have the advantage of covering large areas, having a fixed speed and altitude, and allowing to be used under different weather conditions. Drones are seen as a crucial tool for archaeological conservation, as they can set the boundaries of the sites' protection area. They can also monitor these sites and create digital archives for them, building awareness among the population or helping to reconstruct the damaged sites (Musson *et al.*, 2013).

2.2.1. UAV photogrammetry for a presumed city - Çatalhöyük

It seems that the first map in the world – in fact a landscape painting resembling a map – was created in 6200 BC (according to radioactive dating) in Mesopotamia, were the civilization was born, in the most impressive of the Neolithic villages, named Çatalhöyük, situated in Anatolia, modern Turkey (Fig. 2). The painting is considered to be a plan of the settlement and it presents about 80 houses clustered together, the entrance being cut through the horizontal roofs. In today's virtual reconstructions, Çatalhöyük is mapped with multi-staged houses, having the exit through the ceiling.

Fig. 2. The bird's-eye view of Çatalhöyük, the first map in the world. Painting from the walls of a shrine at Çatalhöyük (Turkey)

The inhabitants drew the map of their city from a bird's-eye view and from now on, later civilizations followed this pattern of representing maps of their settlements, as a convention. The map describes, seen from above, in a vertical projection, a village and a volcano that erupted, in a schematic landscape representation, graphically distorted in order to communicate reality in an efficient way (Kriz, 2013). The plan can be seen in the Museum of Anatolian Civilizations in Ankara.

The first cities did not appear suddenly, but over a period of hundreds or thousands of years (Mlodinow, 2015) and this slow evolution makes difficult to appreciate the moment when a village can be classified as a city. When the site of Çatalhöyük, covering 13 hectares, was discovered in 1960, it was considered that the remains belong to a city. Nowadays, when discovering the vestiges of an ancient settlement, specialists are considering that the differentiation between a big village and a big city is made by the fulfilment of several conditions, such as: the presence of an important river nearby, the occurrence of a strongly hierarchically developed society, the existence of gods protecting the city, the increased specialization of activities. But, although 5,000 people lived in Çatalhöyük (8,000 according other opinions, meaning 2,000 families) in neighbouring houses, artefacts show that there is no labour division, each family conducting independent daily activities. The people in Çatalhöyük were connected only through a common culture and shared spiritual beliefs. This is the reason why archaeologists do not consider Çatalhöyük a city, but a Neolithic village.

The Çatalhöyük 2015 Archive Report (Members of the Çatalhöyük Research Project, 2015) describes the final result of

using **UAV photogrammetry**, respectively a very accurate map of the site. The **drones** were used in low flights for each area of excavation and in high flights for the landscape. 2D and 3D digital maps resulted, such as geo-referenced photos, the digital geo-referenced photo-plan of the site (2 cm accuracy), the Digital Terrain Model or the Digital Surface Model of the site.

2.2.2. Aerial photos of the first planned city – Uruk

Aerial photos followed by high resolution satellite imagery (Fig. 3), were used after 2001 in order to discover potential illegal digging and to acquire better knowledge on the structure of the city of **Uruk** (or Warka, in Arabic), the most outstanding of the first cities, which appeared around 4,000 BC in the Near East as an important force in the trend towards urbanization.

The city of Uruk is located in South-Eastern Iraq, near the modern city of Basra. Most of its territory is desert, yet its geography is attractive since in the middle of the region the Tigris and Euphrates rivers form a fertile plain – Mesopotamia, i.e. "between the rivers" in ancient Greek. Unlike any other city in Mesopotamia, in Uruk the urban life, between 3500 and 2900 BC, is best exemplified (Enciclopedia Universala Britannica, 2010). In Uruk (considered to be the oldest city in the world) urbanization had become possible by digging irrigation channels (one of the wonders of the ancient world) and by the expansion of food supplies.

Uruk exceeded in size any other ancient settlement. Archaeologists have discovered that Uruk had between 50,000 and 100,000 inhabitants (even 200,000 according to other opinions), 10 times more than in Çatalhöyük. At the end of the 4th Millennium BC the city had 230 hectares, and reaching 500 hectares at the end of the 3rd Millennium, when the city was surrounded by defensive walls 10 km long, with 900 towers, each 9 metres high (Fig. 4).

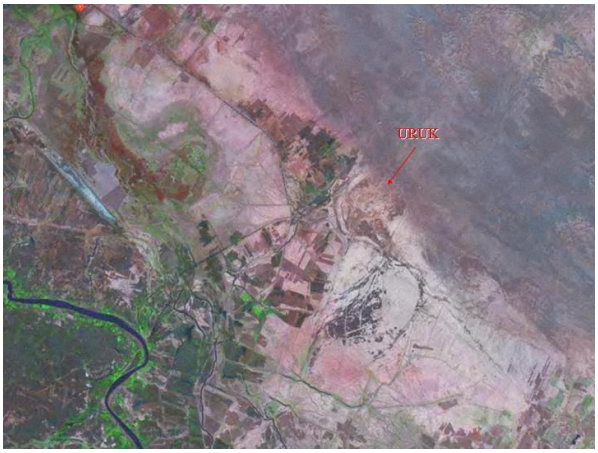

Fig. 3. 30m resolution Landsat image of Uruk ©Landsat TM imagery provided by NASA/A.Sherratt, 2004

Fig. 4. Uruk, the first planned city in the world © Jodi Summers, 2014

In Uruk, the political and religious centre of the city was the architectural complex named Eanna (Gates, 2003). The plan of the city and its architecture show a hierarchical society. The urban lifestyle required a centralized organization, the development of exchange systems and shared systems for the storage of surplus food. This is why thick defensive walls, adapted roads and large buildings were necessary to be built. The demand of

information has led to the emergence of an intellectual, specialized class, as well as to the development of systems for reading, writing and arithmetic.

2.2.3. Aerial photos of a primordial city - Ur

In 2014, as part of a program for the conservation and maintenance of the site, **drones** were used to capture aerial photos of the UR archaeological site (Carlucci, 2014). The hundreds of frames taken by the UAV formed the first ortho-photomap of the UR archaeological site. According to the same cited source, archaeological remains were viewed from above of 150 meters of altitude with a good resolution (the average resolution is 20 cm).

The city of Ur, one of the oldest cities in Mesopotamia (Curtis *et al.*, 2008), was founded about 2100 BC, by the king Ur-Nammu, becoming the economic and political capital of a centralized state and dominating Mesopotamia for 100 years. It developed irregularly, as all primordial cities did. The houses dating from the Ur I period were small, with an area of 25-30 square meters and a small number of rooms. Narrow streets divided the city into neighbourhoods with houses clustered together. There were many canals used for the irrigation of crops.

In 1835 an English archaeologist realizes that this deserted region had covered many cities in antiquity and archaeological excavations have revealed ruins of ancient biblical fortress Ur. The city was dedicated to the god of the Moon (Nanna), the religious assembly being dominated by a towering ziggurat, whose remains are present today. The inscriptions reveal that both temple and defensive walls and canals were rebuilt. A mosaic dating from the Uruk period was discovered inside the temple (Daniel, 1983), and the high artistic level that had been reached in that period is proved by the furniture and objects found in the royal tombs discovered in 1922. The city's decay occurred at the end of the IIIrd Millennium.

2.2.4. GIS and GPS techniques for the largest city of the ancient world- Babylon

In another important Mesopotamian city, Babylon, technology played an important role after the year 2000, archaeological survey including satellite images, GIS and GPS techniques together with surface and sub-surface survey tools.

Founded in the late third millennium BC, the city of Babylon, the religious and political capital of the kingdom of Hammurabi, knew its peak in the VI century BC, when it was regarded as a place of prosperity and happiness (Van der Spek, 2008). It is even said it was the largest city in the world, so great that, according to Herodotus, its residents had received the news of its conquest only a few days after the event.

The city plan of Babylon reveals that the city, which covers 100 hectares, was surrounded by a defensive wall of 11 km having three successive walls and a ditch filled with water. The royal palace had 200 rooms and 5 large patios. Here can be found one of the 7 wonders of the world – the Hanging Gardens of Babylon and also the most famous ziggurat of Mesopotamia, identified as being the mythical Tower of Babel (Walton, 1995).

2.2.5. Remote sensing data for a universal city - Persepolis

Aerial photographs were taken during surveys over the site of Persepolis even since 1935 in the scope of aerial mapping and exploration. Recently, remote sensing data together with field survey methods were used in archaeological researches, and air photos and images were taken at

Persepolis, one of the most important world heritage archaeological sites (Behnaz and Samani, 2006). Reconnaissance flights helped to map features that were known only from ancient writings and photographs were taken at different hours and in different seasons in order to obtain correct photographic results. Vertical photographs described the general mapping of the area, while oblique photographs depicted the remains already in the process of being excavated. More than four hundred ancient sites were mapped in the Persepolis region in only 13 hours of flying.

The city of Persepolis, whose ruins are located in the southwest of present Iraq, was one of the capitals of the Persian Empire, that stretched from the Nile to the Indus. Bringing together Mesopotamian, Egyptian and ionic influences, the city was founded around 520 BC by King Darius I. Architects and builders have worked almost two centuries to build this city, which was meant to be universal (Gwilt, 1851).

Grandiose gates ensured the entry into the city, leading to a sumptuous palace complex, located on a terrace built into the mountain. The city, composed of gardens and houses, lied in the plains. The main activity of the city consisted of agricultural exploitation, ensured by the sewerage network that supplied the city, the gardens and the fields. The cuneiform royal inscriptions engraved in the constructions and the clay tablets showed that the city of Persepolis had a central role in the Persian Empire, as administrative and religious centre.

2.2.6. GPS and air photogrammetry for a city in the middle of nowhere – Al Rawda

The expansion of urbanism that occurred in Mesopotamia during the Uruk period was followed by a **second urban revolution** that took place in Syria, in the IIIrd Millenium BC (Castel and Peltenburg, 2007).

Discovered in 1996 in an archaeological survey, the site of **Al-Rawda** was excavated until 2002, and geo-archaeological studies were done (Gondet and Castel, 2004). Aerial photographs and satellite images were obtained and also a GIS has been developed.

The City of Al Rawda (Al Rawda tell, in Syria) was founded around 2500 BC, in an arid region, a depression situated halfway between the Mediterranean Sea and the Euphrates river, away from the famous cities of Mesopotamia. Archaeological excavations have brought to light the remains of an economically grandiose city. Although urbanization seemed impossible in this arid region with no roads, the city played a key role in the urban development of the entire region.

Fig. 5. Hypothetical view of Al Rawda
© Franco-Syrian archaeological mission of Al Rawda

The city, a circular site of about 16 hectares, of which 12 ha in a circular enclosure, (Fig. 5) was created following a geometric town plan, extremely coherent, that could accommodate several thousand people, providing a dense coverage of the territory. Its urban plan reveals a typical Syrian

urban model, being a possible witness of an authentic spatial planning policy. Images of the radial street network were offered by magnetic maps (Gondet and Benech, 2009). The city had a defensive function (according to its 4 lines of fortification), as well as religious and funeral functions (the big temple and the other 2 smaller ones respecting this type of plan and occupying almost a third of the built area).

The fact that this agglomeration, occupied for 300 years (between -2200 and -2500 BC), experienced few subsequent disturbances, offered ideal conditions for archaeological excavations that occurred after 2000 (i.e. in 2002 and 2010). Another reason for the research was to find out why and who founded the city, and why it was abandoned. Therefore, in addition to geo-physical prospection, **GPS systems and air photogrammetry** were used to study a 100 square kilometres area having Al-Rawda in the centre. A system of dams was discovered, ensuring the irrigation of crops. All archaeological discoveries showed that the city had an extensive trade network (apparently being a stop for caravans). This is why the city's voluntary abandonment is not yet known, as it is not justified neither in terms of conflict or climate.

3. Discussion and further steps

The article represents a comparative analysis of the methods and techniques used to represent cities throughout history, from ancient times until present days. It refers to urbanization and historic cartography and discusses the use of modern technologies in mapping and the protection of the remains of ancient cities.

The study focused on a time period in which the first cities were born. The ancestors of modern cities and urban agglomerations, which developed starting with the 4th Millennium BC, were "modest" cities of maximum 200,000 inhabitants. In contrast with the few urbanised areas from ancient times, nowadays, more than half of the world's population lives in cities (Villiers M., 2015). Statistics show that every day, the existing urban population grows by a number of 190,000 people. If 40 years ago there were only 2-3 urban agglomerations with more than 10 million inhabitants, today there are 30.

If in the 17th century the city views were presented in dedicated city atlases, published in Germany, Italy and France as engraved illustrations, nowadays they can be precisely obtained by modern means of data collection and representation. Besides the classical surface and sub-surface survey tools, there is a wide range of applications of *modern technologies*, such as UAV photogrammetry (drones), high resolution satellite imagery, GIS and GPS techniques and they are capable of obtaining 2D and 3D digital maps and highly accurate geo-referenced photos and photo-plans.

The ancient cities are important witnesses of the beginning of civilisation and thus they must be known and protected. Moreover, old maps represent important historical documents presenting the spatial relations in the past. The use of new technologies in locating and mapping ruins of ancient urban settlements is a way of ensuring their protection, as well as a way to preserve the past.

These are not surprising results, since they are **in accordance with recent studies** outlining the capabilities of aerial photography and satellite images in acquiring the features omitted by classical maps, and mentioning the GIS tools and

functions that allow visualisation, virtualisation and 3D models (Nieścioruk, 2016). Besides that, the results of other recent studies are in total compliance with the results of the present one, outlining the huge **practical** potential of these technologies that can be used to find solutions for urban issues by studying the historical development of old cities (Alqatrani, 2015). These practical results can be further extended to face modern concerns, such as using remote sensing images for change detection in land-use cover in urban areas, in order to quantify spatial and temporal characteristics of the urbanization patters and the dynamics of urban expansion (Atak *et al*, 2014).

During the research, the authors intended to present examples of using modern data acquisition techniques at national level in similar preoccupations, but the lack of information and available data represented an obstacle. This is why we believe that a similar research can be done in the case of **Romanian ancient cities** – such as the Roman and Greek cities, situated close to the Black Sea coast or the Danube, in order to promote new tools that can help archaeologists and urban planners to locate and, finally, to protect important national heritage sites.
The present article is partially based on a previous study (Tache et al, 2010), which resulted in the development of a geospatial integrated system for the location and protection of archaeological sites, and in which the main author of the article was directly involved. The research focused on the methods used to precisely determine the location of ancient archaeological sites of national importance in Tulcea County in Romania.

We believe that, on the basis of the results of the current study, the research can be further deepened, through a new theoretical and practical approach which recommend the use of the new non-invasive technologies in the field of urban and spatial planning and archaeology, in order to obtain more accurate results.

4. Conclusions

In conclusion, modern digital technologies help archaeologists and planners acquire a better understanding of the importance and characteristics of ancient cities, as places where civilization and urbanization were born. Sciences with a strong spatial character, such as spatial planning or archaeology are no longer making use of classical approaches – which are often approximate, incomplete or erroneous – but, starting with the middle of the last century, they rely on new technologies which initially had a limited applicability. Technologies such as aerial photogrammetry and satellite imagery, Radar and LiDar, space-based navigation systems, geo-processing, change detection - represent innovative tools that can be used in activities related to land management, in urban and spatial planning or in archaeology. By exploiting the potential of ICT and developing an economy based on knowledge and innovation, "smart growth" can be achieved, which is a goal underpinning the Europe 2020 Strategy.

Acknowledgements

The idea of this research was based on findings and conclusions emerged from the CENTRIC project – ***C****entre of* ***E****xcelle****n****ce in* ***T****erritorial* ***M****anagement and* ***C****adastre*, project no. 664573, developed under H2020-WIDESPREAD-2014-1. The project aims in its first step to develop a complete business plan and strategy of the future centre. Being the only selected project from Romania in the H2020 Program in WIDESPREAD competition,

it has as Lead Partner the National Agency for Cadastre and Land Registration, and, as a second Romanian partner, INCD URBAN-INCERC. Partners from Italy, Germany, Belgium and Luxembourg are representing important cadastral agencies, universities and companies working in the geo-spatial field. The project is dealing with major digital technologies that are actually used to deliver, process, update, integrate and visualise geo-data, such as Location Based Services, Unmanned Aerial Vehicles, Big Data, 3D Modelling and visualisation.

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Received: 14 February 2016 • **Revised**: 31 March 2016 • **Accepted**: 2 April 2016