الجمعية الجغرافية الليبية

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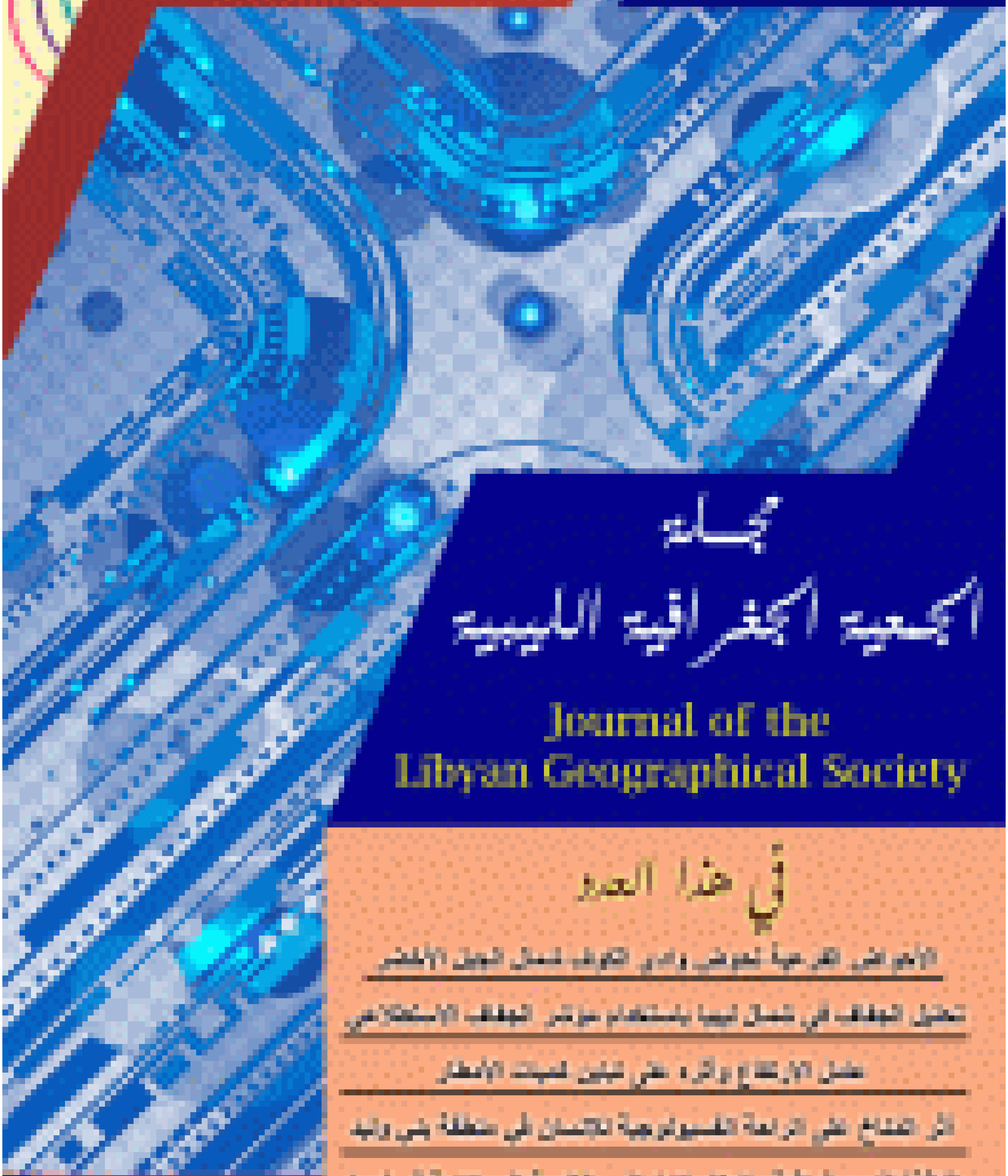

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مجلة علمية محكمة نصف سنوية

تصدر عن الجمعية الجغرافية الليبية

العدد السادس ديسمبر 2021

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- أمانة التخطيط "النتائج النهائية للتعداد العام للسكان فى ليبيا سنة 1973" (طرابلس : مصلحة الاحصاء والتعداد، 1973).
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محتويات العدد

الافتتاحية

بسم الله الرحمن الرحيم

﴿يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ﴾ سورة المجادلة آية ﴿11﴾

لقد آلت الجمعية الجغرافية الليبية على نفسها أن تفي بوعودها للجغرافيين بنشر بحوثهم العلمية منذ تأسيسها بإصدار مجلة علمية تتضمن البحوث التي تمت المشاركة بها في المؤتمرات الجغرافية.

وفي هذا السياق يسّرنا أن نعلن لزملائنا من الجغرافيين أنه بفضل الله وتوفيقه أصدرت الجمعية الجغرافية الليبية المجلة التي تبنتها بنسخة إلكترونية محكمة، مع إلتزامنا بالمعايير الدولية للنشر كما عوداكم سابقاً، وستتوالى الجمعية الجغرافية إصداراتها (نصف السنوية) بعون الله بصورة دورية، وسنبذل قصارى جهدنا لكي نتبوأ مكانة مرموقة في الوسط العلمي وبين المجلات العلمية الأخرى، ولكن ذلك لن يتأتى إلا بتوفيق من عند الله وبدعم الباحثين والمحكمين.

ومن هذا المنطلق، انتهز هذه الفرصة لأدعو جميع الجغرافيين لنشر أوراقهم البحثية بمجلة الجمعية الجغرافية الليبية العلمية المحكمة وتقديم مقترحاتهم ونقدهم البناء، ونحن برحابة الصدر سنتقبل كل ذلك مادام له أثر إيجابي في تميز هذه المجلة، وندعو الله أن نحقق بهذا المجهود ما نصبو إليه، وسوف تكون هناك إعداداً خاصّة للأوراق البحثية التي يتم المشاركة بها في المؤتمرات الجغرافية القادمة.

واخيرا يكون لزاما علينا ان نهدي هذا العدد الى زملائنا وأساتذتنا من الجغرافيين الذين انتقلوا الى رحمة الله وفي مقدمتهم الأستاذ الدكتور الهادي مصطفى أبو لقمه باعتباره أحد مؤسسي الجمعية الجغرافية الليبية وأول رئيس لها... داعيين الله العلي القدير أن يتقبلهم بواسع رحمته.

والله ولي التوفيق

أ.د. مفتاح على دخيل

رئيس التحرير

Converting the Mental Maps to Digital Data in Geographic information system –GIS in The Old City of Tripoli, Libya

Dr. Fuzia Taher Elkekli

Department of Geography and Geographic information system / University of Tripoli

ملخص

يعد دمج آراء أصحاب المصلحة تحديًا للمخططين الحضريين، لا سيما عندما تكون الأحياء والمباني مهمة لتاريخ بلد بأكمله، خاصة اذا ما اعتمدت الدراسة نظام المعلومات الجغرافية كأسلوب علمي ترتكز عليه الدراسة وفرضياتها.

التحدي الكبير هو كيفية استخدام معلومات الخرائط الذهنية في طبقات نظم المعلومات الجغرافية، هذا هو الحال مع المدينة (المدينة القديمة) في طرابلس، ليبيا، المنهجية المقترحة هنا تتخذ نهجًا تشاركيًا (جمع وتحويل آراء مجموعة متنوعة من الناس(الخريطة الذهنية) حول المدينة القديمة يتعلم معظم الناس التنقل في محيطهم أو حتى في منطقة غير معروفة، لرسم طريقة في أذهانهم لأهم الأماكن والطرق لتكون خارطة الطريق لرحلاتهم اليومية، في معظم الأوقات، كانت هذه الخرائط تتطلب الكثير من الجهد والتردد للاستفادة منها في البحوث العلمية، حيث قامت الباحثة بتجميع الآراء المختلفة لتكون واحدة من النقاط الرئيسية لطبقات المنطقة في نظم المعلومات الجغرافية، حيث تساعد نتائج هذا البحث في تشكيل إستراتيجية قابلة للتطبيق للمقيمين والمقيمين السابقين والأشخاص المهتمين والمخططين والمطورين لفهم كيف يمكن لتصورات الناس أن تؤثر على جهود الحفظ في المدن التاريخية. وهذا البحث يقوم بتحويل رأي الناس (المعلومات الاجتماعية لتكون طبقة في طبقات نظم المعلومات الجغرافية في منطقة الدراسة) باستخدام أدوات نظم المعلومات الجغرافية لإضافتها إلى نتائج طبقات المنظقة التي قد تصور الاتفاق أو التناقض بين آراء الخبراء وواقعية المدينة القديمة.

الكلمات المفتاحية: المدينة القديمة ، المدينة الإسلامية ، التدهور ، الهوية ، نظام المعلومات الجغرافية (GIS)

ABSTRACT

Incorporating the opinions of stakeholders is a challenge for urban planners, particularly when neighborhoods and buildings are important to the history of an entire country. In the other hand, the methodologies was chosen for the study is Geographic information system to analyze the layers that have for area of study. The big challenge is how to use the mental maps information in the GIS layers. This is the case with The Old City of Tripoli, Libya. The methodology proposed here takes a participatory approach (collecting and converting the opinions of a variety of people about the Old City of Tripoli) Most people learn to navigate in their surroundings or even in unknown territory, to draw a way in their mined of most important places and roads to be the roadmap for their daily trips. Most of the time these maps are as with much effort and indecision these observation caried out the different opinions to be the one of main points for the research. The findings of this research are helping to form a viable strategy for residents, former residents, interested people, planners, and developers to understand how people's perceptions can affect the conservation efforts for historical cities. The use of geographic information system (GIS) technology provided layers of the area of study, this research is converting the opinion of people (social information to be a layer in GIS layers of the area of study) by using GIS tools to added to the GIS layer results depicting the contrast between the informants' opinions and the realty of the Old City of Tripoli.

Key words: The Old City of Tripoli, Islamic city, deterioration, identity, geographic information system (GIS)

Introduction

Thus, there are numerous factors inherent in individual observers that can affect their mental images: education, age, size of the city, economic situation, society, and their social position in particular. Mercer (1971) stresses that "the notion that such factors as place of residence, mobility, socio-economic status and personality influence the variable perception of the structure of large urban areas is now almost regarded as a sine qua non of studies of the spatial aspects of consumer behavior or residence change" (Mercer 1971, 133). Indeed, some studies of mental maps have attempted to reconstruct the process of their formation and have emphasized the observations of individuals that have built their image of the environment (Tolman 1948; Graham 1976; Matei et al. 2007). Matei et al. (2007) describe mental processing as:

> we learn, process and store information that is spatially-located more easily than information that is divorced from specific locales or temporal frameworks. We are able to retrieve vast amounts of information, meaning, feeling and experience from our real world…because we store a good deal of that information using spatial referencing as a main indexing mechanism. (47)

In just this way, people living in certain places or walking spontaneously in significant streets for periods of time are able to make mental maps and most of the time they use that information automatically. The work here is based on the assumption that

even though observation is the basis of the individual's mental maps, the person's background is responsible for drawing a unique image that has a link between the person's observation and the situation's reality. Thus, this study was designed to explore the intersection of primary contexts: the context of social and temporal perceptions, the mental maps of individual informants, and the concrete spatial context of The Old City of Tripoli in Libya as recorded by the MHC.

The theoretical and methodological framework for this study is founded in a fusion of mental maps and GIS technology. Combining multiple mental maps with GIS technology allows the construction of collective opinion surfaces (COS); that is, surfaces that reflect the collective opinion of multiple informants. The following paragraphs discuss mental maps, GIS technology, and their combination for this study.

The Objective of the Study

The objective of this paper has been to present a methodology for using mental maps to incorporate stakeholder opinion in the planning process. This section of the paper summarizes results from the preceding analytical section, finding areas of agreement and disagreement between the COS and MHC surveys and maps. It will discuss these analyses in the context of using mental maps to create space for dialogue between urban planners and stakeholders.

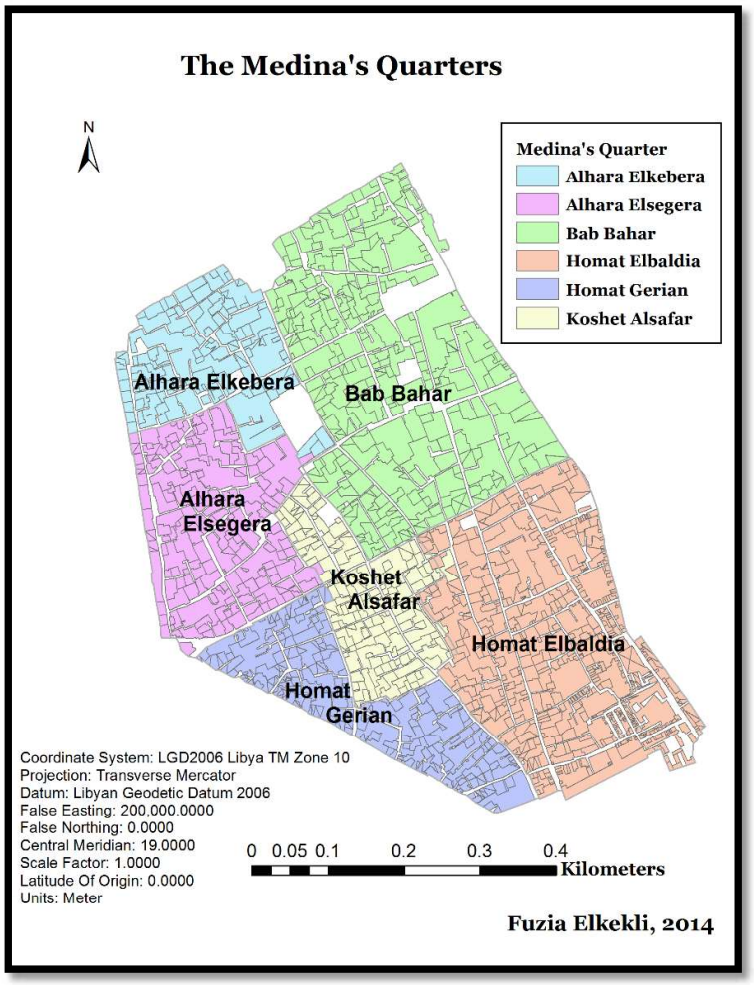
The area of the study

The Old City of Tripoli (labeled as Old City in Figure 1) is located at 32°54′8″N 13°11′9″E in the northwest section of Tripoli, Libya, North Africa. The Mediterranean Sea is the border on the north and northeast; the wall surrounding The Old City of Tripoli is the border on the south and southwest. The area gradually descends from the north to the south; the highest elevation of The Old City of Tripoli is nineteen meters above sea level, and it descends down to the lowest point of six meters in the southeast corner of The Old City of Tripoli.

Source: Magellan Geographic, 1996.

Figure 1. Map of Tripoli indicating the area of The Old City of Tripoli (Old City).

The Old City of Tripoli contains six quarters (neighborhoods) connected by zangas (alleys) with no clear borders or gates between those neighborhoods. The types of buildings include many mosques: the Al Naqah Mosque (the oldest mosque), the Karamanli Mosque (the largest mosque), along with other historic mosques; additionally, zawayas (Sufi workshops), main banks, traditional hotels, agencies, museums, traditional cafes, archeological sites, sport clubs, huge historic houses used as libraries, traditional suqs (marketplaces), suqs selling modern goods, open markets, houses, diplomatic buildings, service, and residential areas, the famous Roman Citadel, and multiple museums occupy the space; nonetheless, the majority of buildings are residential. In general, the pattern of narrow streets dates from the Roman era and major circulation occurs in typical traditional transportation (mostly walking) patterns both at the outer edge of the district and by some of the interior streets. Public and individual vehicular transportation is rather difficult inside The Old City of Tripoli because of the narrow streets built according to Islamic tradition, and for this reason, most residents and visitors walk.



Source: Work of Researcher Elkekli, 2013-2019.

Figure 2. The Old City of Tripoli's quarters.

Aim of the Study

Even though the area is considered a historic place, it has modern buildings distributed throughout the traditional fabric. In addition, some of the buildings have changed because of the introduction of modern infrastructure (plumbing, electricity) and because of residents' attempts to conserve and remodel their homes. Like people

around the world, they have adapted their buildings to function in a more modern setting and style and to improve their economic status.

In spite of these building and infrastructure updates, The Old City of Tripoli of Tripoli is quite different from cities to which modern urban planning methods are customarily applied; it is not only regarded as an Islamic city, but also has been the subject of a particular political situation over the last half century. As the hypothesis is any kind of study should company the opinions the cohabitants as part of the interests of the area of study. The hypothesis believes that any flexible plan should has all the opinions of the disunion makers and residents too.

The aim of this study is to support urban preservation/conservation efforts, this study details those contexts in some depth. Due to the paucity of sources available about Libya over the last four decades, primarily because of the lack of communication with the outside world during Gadaffi's strict regime (1969–2011), many reliable sources are older in origin. However, especially since the 2011 uprising, more material in all media types has become available in both Arabic and English.

Defining the Islamic City

What defines an Islamic city is a continuing matter of debat. Bonine (1976), Abu-Lughod (1987), and Lapidus (1967) stressed the idea of the Islamic cities' structure as the footprint of religious influence. Bonine's viewpoint is that the study of Islamic cities needs more time, especially to obtain the proper framework and outlines that will help in

the debate over the characteristics of Islamic cities. This researcher believes that the debate should be more about when the Islamic cities were established rather than about analyzing the cultural impacts that shape them. The views of those like Marcais (1958) focus on elements that interact with The Old City of Tripoli as a fabric related with religion only. Abu-Lughod and Marcais have adopted The ory of Ibn Khaldun, a fourteenth century historian and political theorist, whose idea of the city, inspired by Islam, must be judged by his understanding of civilization, royal authority and dynasty. Rosenthal (1958) has the following view:

> furthermore, towns and cities with their monuments, vast constructions, and large buildings, are set up for the masses and not for the few. Therefore, united effort and much co-operation are needed for them. They are not among the things that are necessary matters of general concern to human beings, in the sense that all human beings desire them or feel compelled to have them. As a matter of fact, [human beings] must be forced and driven to [build cities]. The stick of royal authority is what compels them, or they may be stimulated by promise of reward and compensation. (433)

Indeed, most studies argue that structuring an Islamic city, a The Old City of Tripoli, started with establishment of the mosque in the first settlements (Hakim 1986; Abu-Lughod 1987; Lapidus 1967). This researcher disagrees with that limited explanation because some The Old City of Tripoli are structured in much more complex and

heterogeneous ways. For example, churches and synagogues have long been present in The Old City of Tripoli of Tripoli; some of these institutions predated the establishment of mosques. Although these religious buildings did not, and do not, function as a central point or focus for the majority of the population, they were or are so sufficiently important that they ruled out the designation of The Old City of Tripoli as a so-called fundamental Islamic city—even though it is both Islamic and one of the oldest cities in the world.

Preservation of Islamic Cities

As in all urban conservation efforts, planning must confront stereotypes of what was or should be conserved. Bonine (as quoted in Blake and Lawless 1980) concluded that, "the traditional Middle Eastern city is still being explained in clichés and stereotypes" (Blake and Lawless 1980, 183). Bonine guided the debate into the reality of the stereotypes in order to find the reality of conservation. This idea is tied strongly with the idea of studying the residents' mental maps. Under all these influences, complex and interwoven, the testimony of life lived in such a place perhaps can shed light on what are the true outcomes of these influences for the present and future of such a city.

Mental Maps

Creating images of lived-in space, whether in the mind or in recorded formats, has been common throughout human history. Geographers such as Gulliver (1908) and Trowbridge (1913) studied how people have graphically represented their surroundings. Tolman (1948) used the term "mental maps" in the field of cognitive psychology to

describe how people navigate through space, especially familiar space, and the term has been adopted for the imaginary maps people carry in their minds as they move in geographic space (Dalton and Bafna 2003; Graham, 1976).

Further development of the concept of mental maps as a geographic tool was done by Lynch (1960) who determined that the technique of sketching was an innovative methodology that could help represent urban space. He also stressed that "there is more than the eye can see, more than the ear can hear, a setting or a view waiting to be explored" (Lynch 1960, 1). Further implementation analyzed the process and other researchers, including de Alba (2011) and Matei, Miller, Arns, Rauh, Hartman, and Bruno (2007), stated that geo and temporally contextualized information is of much more value than information without context because in geographic studies, contextualization is essential. They claimed that society benefits from the variety of situations and contexts that are used to arrive at proper knowledge and understanding by processing information spatially and temporally; they further stated that information in context is easier to remember and can affect the manner in which we acquire knowledge (Matei et al. 2007).

Most people learn to navigate in their surroundings or even in unknown territory, but sometimes with much effort and indecision. For the researcher, acting from individual mental maps involves moving through space and finding places which have been grounded in an individual's known sense of direction. "The mental map is essentially structured by the spatial elements, which then may be elaborated, or fine-tuned by the

addition of visual elements" (Dalton and Bafna 2003, 3). Mental maps contain information not just on physical space but often on its more ephemeral qualities. Necessarily, these connotative qualities are a function of the individual psychology of the observer.

Thus, a mental map is not a static object but a system of relations between individuals and the space they inhabit. All people use mental maps or a visual display inside their heads that shows what the people—in their own way—know about the location and the uniqueness of a place (Graham 1976). A mental map is a way of conceptualizing how people receive information from their environment and how they use their senses to construct an image of the world around them. Concerning the urban context, a particular visual quality is that of the apparent clarity or "legibility" of the cityscape because it is, in particular, enriched with information about social relations. Lynch further stated that the image of the city was the result of the "process between the observer and his environment. The environment suggests distinction and relation, and the observer—with great adaptability and in the light of his own purposes—selects, organizes, and endows with meaning what he sees" (Lynch 1960, 6). Lynch concludes: "The image of a given reality may vary significantly between different observers" (Lynch 1960, 6). In a sense then, the internal image held by individuals is a dialogue between themselves and their environment; where and how individuals see themselves fitting into

their social environment is a crucial factor in shaping their mental map. Gould (1973) stated that:

> one of the shared areas of scholarly and practical interests to emerge…has been the broad subject of environmental perception and cognition…behavior frequently appears to reflect the images…of the social and physical environment around them, rather than the 'true' environment—whatever that might be, and however it might be defined and measured. (13)

Geographic Information Systems (GIS)

GIS technology is an integrated collection of software, data, and applications used to view and manage information about places and analyze and model spatial relationships and processes. It provides methods and tools that play an important role in analyzing populations (Borruso 2009, 301). Lopez and Lukinbeal (2010) used a mixed-methods approach combining mental mapping with GIS, first-hand observation of the community, and interviews. The implications of their research on future endeavors in crime, mental mapping, and qualitative GIS show how comparative analysis can be deployed to help mediate perceptual differences. Haque (2001) states that GIS is particularly useful for engineers and planners as a tool for management of built environments and the system has a vast listing of possible uses.

Combining Mental Maps with GIS

Combining mental maps with GIS presents some special problems, primarily because this requires the incorporation of non-cartographic data (mental maps) within a GIS environment that is explicitly cartographic in nature. The idea of using mental maps emerged in literature because of the realization of how people observe and make conclusions about their environment and do so in different ways, even for an environment they share. GIS allows the information from mental map sketches of all the informants to be collated and displayed both in digital and visual formats in a variety of aggregations. Also, once the COS data and maps were digitized and converted to GIS format, comparison and analysis could be made of the mental map data and perceptions of the informants to the COS property data. This work uses ideas from Lynch (1960) in terms of using sketch maps to record mental map features and from Lopez and Lukinbeal (2010) who used GIS mapping of crime patterns to compare to perceptions of crime from residents and law enforcement.

What the present study does is to convert social information to GIS formats to aid in comparative analysis. Austin et al. (1998) in their study of transportation of low-level radioactive waste material through Native American lands state, "like other social scientists, the researchers and American Indian partners who designed and conducted this study focus on public perceptions and framed the discussions in terms of locally defined values and concerns" (Austin et al. 1998, ix). Those who agreed to participate in

Austin's study were interviewed individually, and each of them was shown the maps and given the photographs to make sure that they knew the location where those maps and photographs were made; the Native Americans were asked to mark the roads that their immediate family used for travel in a typical year; also those used for hunting, gathering, fishing, and trapping. They were shown the proposed transportation routes for the radioactive waste and were asked what the positive and negative impacts were from the trucks carrying radioactive waste along those routes.

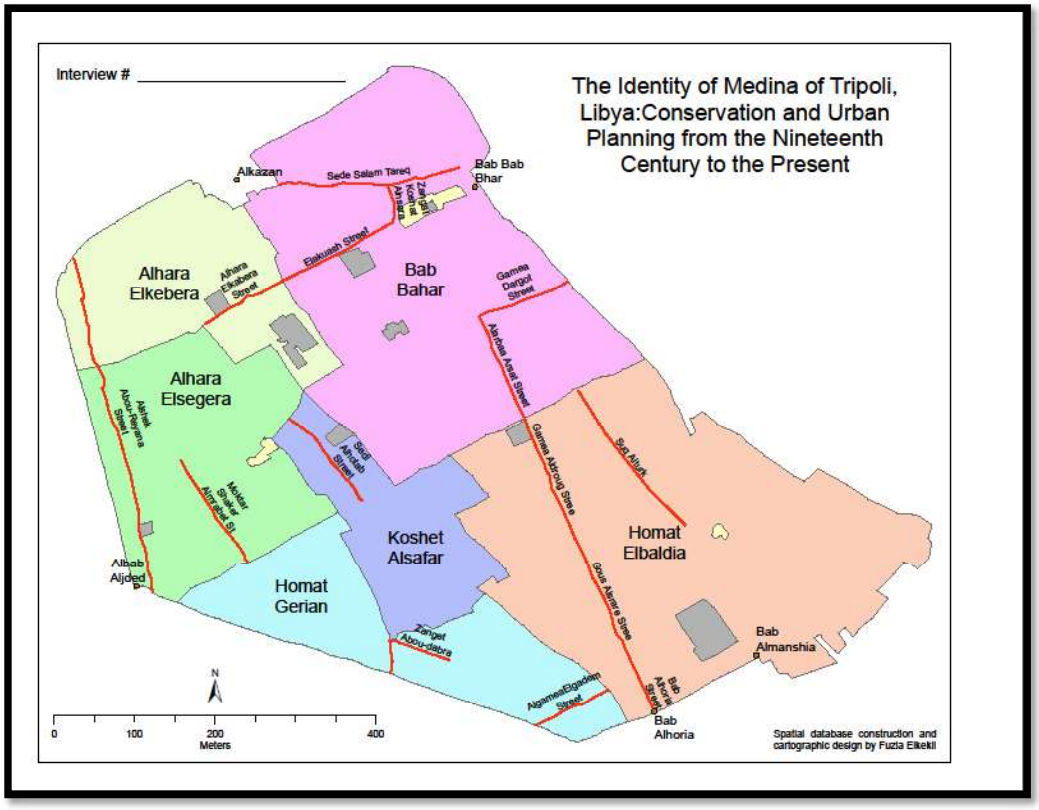
The importance of having the public involved in strategic planning processes was stressed by Morehouse, O'Brien, Christopherson, and Johnson (2010) in their study using cognitive maps and a survey to study the human values and perceptions of their respondents concerning wild land fire risk and strategic planning in four mountain ranges in the American Southwest. They indicated that "incorporation of both spatial and non-spatial data allowed for comparison of values and perceptions within and among different user groups and across the four study areas" (Morehouse et al. 2010, 126). They further stated that by using the digitized map-based responses they were "not only able to capture geospatial information…but also to make comparisons both across individual maps and between groups of maps to attain a better understanding of individual and group perceptions and values in each of the study areas" (Morehouse et al. 2010, 127).

Methodology

The study was initiated to develop a methodology using mental maps to capture informant opinions about deterioration in The Old City of Tripoli. This methodology compared the informant opinions about deterioration to quantified levels of deterioration mapped by the MHC. This part of the paper describes the methodology used to capture informant opinions, transfer these opinions to GIS data, create COS, and compare these COS to the MHC maps of condemned buildings.

Mental Maps

Spatial opinions were collected by asking participants to answer location-based questions by drawing shapes on a basemap of The Old City of Tripoli. This base-map was created using ArcGIS 10.1 (ArcGIS 2014) software and a satellite image of the Old City of Tripoli. It included an outline of the Old City of Tripoli with locations for the city gates as well as divisions indicating the six quarters, important buildings, and main streets. All spatial data used a Universal Transverse Mercator (UTM) Zone 10 projection. The map sheet also had space for an interview number that would allow it to be connected to the non-spatial components of the survey without identifying the participant (Figure 3).



Source: Work of Researcher Elkekli, 2019.

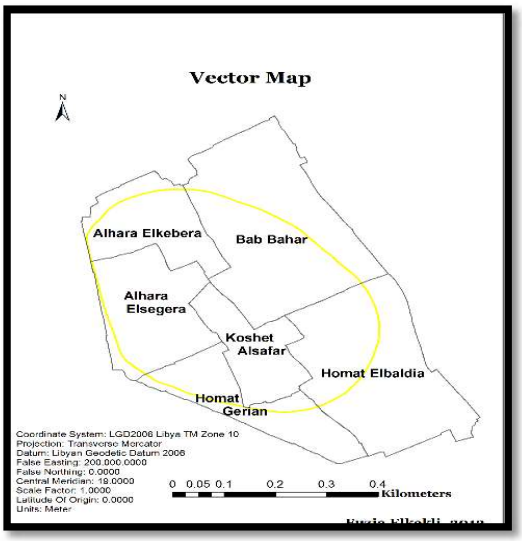
Figure 3. Map of study area for mental maps.

The six quarters are named based on their physical locations or from their social impact and were numbered for this study in order to streamline the analysis: 1) the Bab Bahar quarter, the Sea Gate; 2) the Homat Elbaldia quarter, the area of the districts services and markets; 3) the Koshet Alsafar quarter, the most residential neighborhood because it has more residents than services; 4) the Alhara Elkebera and 5) the Alhara Elsegera quarters, which are the largest and smallest neighborhoods, respectively, that were used by the Libyan Jewish people who once lived there; and 6) the Homat Gerian

quarter, the place of residents who have emigrated from the mountains and other areas of Libya.

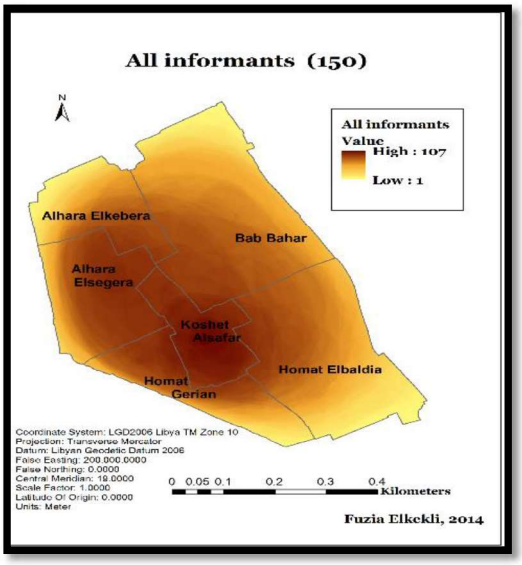
Survey

The informants for this research came from a variety of backgrounds and consisted of 46 females and 104 males over eighteen years of age who were distributed in four groups: seventy were residents of the Old City of Tripoli, both property owners and renters; twenty were former residents who owned houses inside but lived outside The Old City of Tripoli; forty were the MHC staff; and twenty were Engineering Counsel Office (ECO) staff. All participants were familiar with The Old City of Tripoli's quarters and streets. The uneven distribution of females and males in the survey is a product of local traditions. Property is traditionally owned by men, and men are traditionally the spokespersons for their families. Consequently, when the researcher approached residents of The Old City of Tripoli, it was usually the men who were willing to be interviewed. Still, the women interviewed did represent a cross-section of residents and non-residents. Some women were engineers in the MHC and ECO staffs; some were property owners, while others were selling items in the streets.



Source: Work of Researcher Elkekli, 2013-2019.

Figure 4A. Vector data based on mental maps.



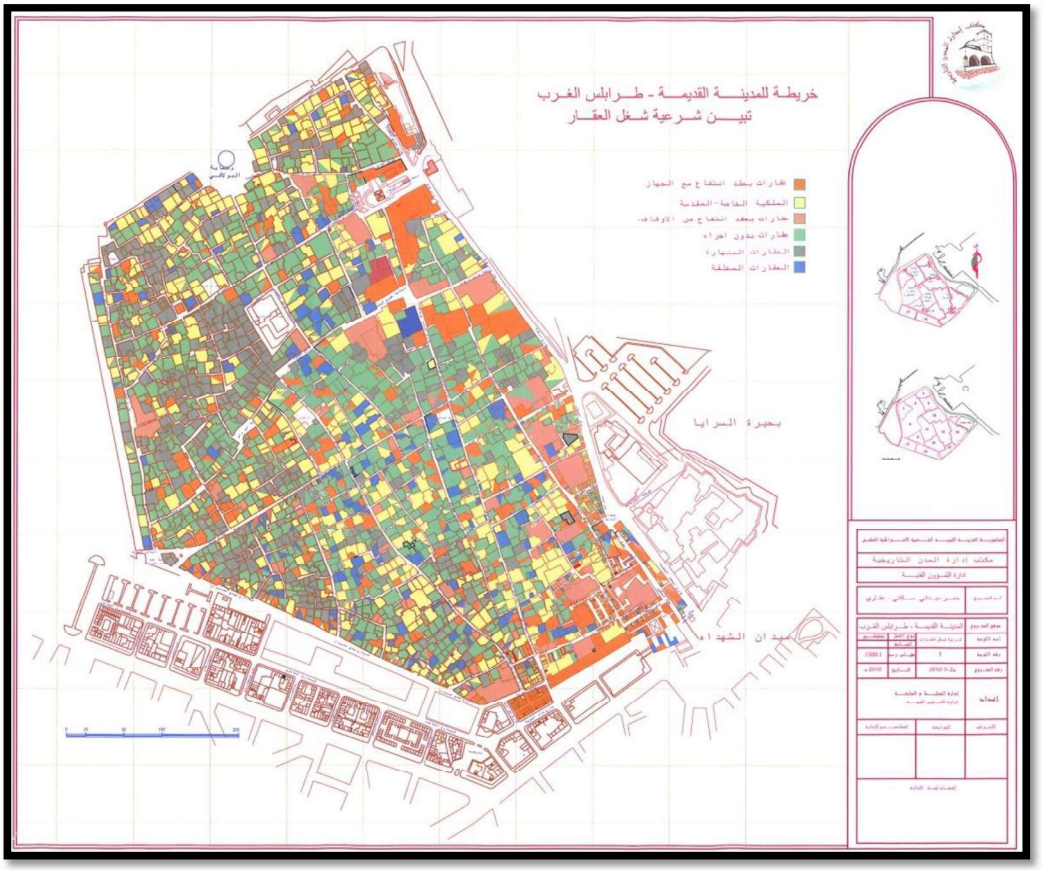
Source: Work of Researcher Elkekli, 2013-2019.

Figure 5A. Cumulative opinion surfaces (COS) of deterioration for all 150 participants.

Converting the Mental Maps to Digital Data in GIS

In order to use GIS to analyze the participants' responses, the lines and polygons the informants created in response to the survey were digitized using a large format digitizing tablet. For this paper that means that the areas they identified as deteriorated were digitized as vector (Figure 4A). These vectors were then converted to Rasters with a cell resolution of one meter. These rasters represented the participants' polygons with ones, and the areas outside of their polygons with zeroes. This process of digitizing and rasterization was carried out for each of the 150 mental maps created by the participants, providing the researcher with 150 raster surfaces identifying each participant's opinion about deterioration in The Old City of Tripoli. Because these opinions are represented by ones and zeroes in a series of georeferenced Rasters, it was possible to sum the Rasters to create COS. In these COS, a raster cell with a ten in it represents a location that ten participants identified as deteriorated, and one with a zero would represent an area that no participant identified as deteriorated. Figure 5A represents the COS of deterioration for all 150 participants. In this map, the low value is zero and the high value is one. High values in this map represent high numbers of participants and low values indicate low numbers of participants identifying a particular area as deteriorated.

The MHC Scanning Map of Property Categories



Source: MHC, 2019.

Figure 6. The MHC scanning map of property categories.

The researcher used the MHC scan map (Figure 6) as a source for quantifying condemned properties. This map was scanned and georeferenced to match the spatial domain of the project geodatabase. Properties from the map were then digitized from the computer monitor and each polygon was given the attribute of the MHC property class. Polygons representing condemned properties were extracted as a separate feature class in the geodatabase. These buildings represented a quantitative measure of deterioration

that could be compared to the qualitative measure represented by the COS based on the informants' mental maps.

Analysis

The comparison of qualitative and quantitative measures of deterioration in The Old City of Tripoli took the form of a series of spatial analytical examinations of these data. First, summary statistics identified the relative deterioration of the different quarters in the Old City of Tripoli based on the COS and the counts of condemned properties. These statistics were used to rank the different neighborhoods. These rankings are then compared to identify differences between the MHC map and the COS maps. Second, visual comparisons of the COS and a density map of the condemned properties were undertaken. Third, a series of Kolmogorov–Smirnov tests (K–S test) determined whether or not differences in the preceding analyses were statistically significant. Finally, cumulative proportion graphs demonstrated the nature of the differences between the COS and the location of condemned properties based on the MHC map.

Based on both the COS maps and the MHC map were created for each quarter of the Old City of Tripoli. Statistics for the COS were created for each informant category; residents, former residents, the MHC and ECO employees, the quarters are ranked for each category, with number one representing the quarter with the highest perceived level of deterioration.

based on the mean of all raster cell values in that quarter, and six the lowest perceived level of deterioration. These rankings are not completely consistent among the different informant categories, but are close enough to inspire confidence that they do represent opinions across the spectrum of informants in the survey. Note particularly that Homat Elbaldia, Homat Gerian, Alhara Elsegera, and Koshet Alsafar have differences between informant categories that are no greater than one rank. Only Bab Bahar and Alhara Elkebera have rank differences greater than one.

Table 1 shows the percent of total area for each quarter that was designated as condemned by the MHC, along with the rank for each quarter. Rank 1 represents the quarter with the largest area by percentage of condemned properties and Rank 6 that with the smallest area by percentage of condemned properties.

Table 1. Condemned properties per quarter by percent of area based on the MHC map.

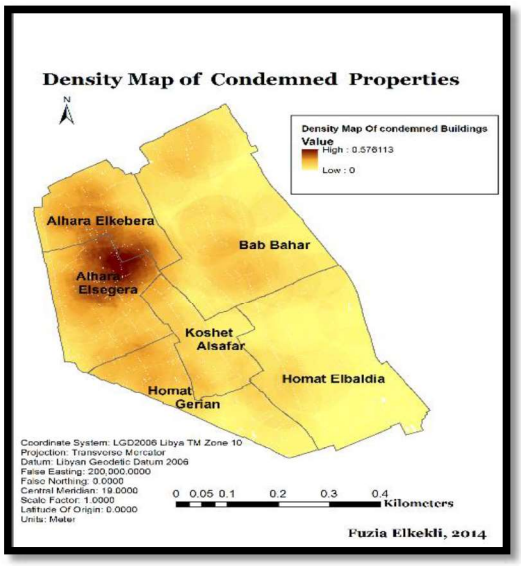
Quarter	Percent Condemned	Rank
Bab Bahar	11.05	4
Homat Elbaldia	3.08	6
Homat Gerian	13.20	3
Alhara Elsegera	30.19	2
Alhara Elkebera	32.57	1
Koshet Alsafar	9.91	5

Because the metrics for the COS and the MHC summary statistics are different, they do not lend themselves to direct comparison, but the rankings can be compared.

Visual Comparison of COS and the MHC Density Surfaces

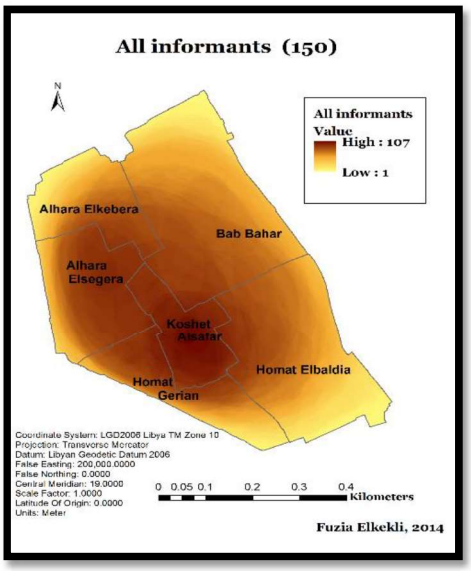
Figures 7A shows the density surface based on the MHC data while Figures 7B to 7F show the COS of each informant category. The dark areas were identified in the COS as those areas believed by informants as having the highest level of condemned buildings while the light areas were seen as areas with little deterioration.

Even a cursory examination indicates differences between the MHC map and the COS maps. A comparison between the MHC map with the COS shows that in the MHC map, the condemned buildings are concentrated in Alhara Elkebera and Alhara Elsegera and part of Homat Gerian, but the COS shows that Koshet Alsafar is the main quarter of condemned buildings because Alhara Elkebera and Alhara Elsegera are both low population areas.



Source: Work of Researcher Elkekli, 2013-2019.

Figure 7A. Density surface based on the MHC identified condemned properties.



Source: Work of Researcher Elkekli, 2013-2019.

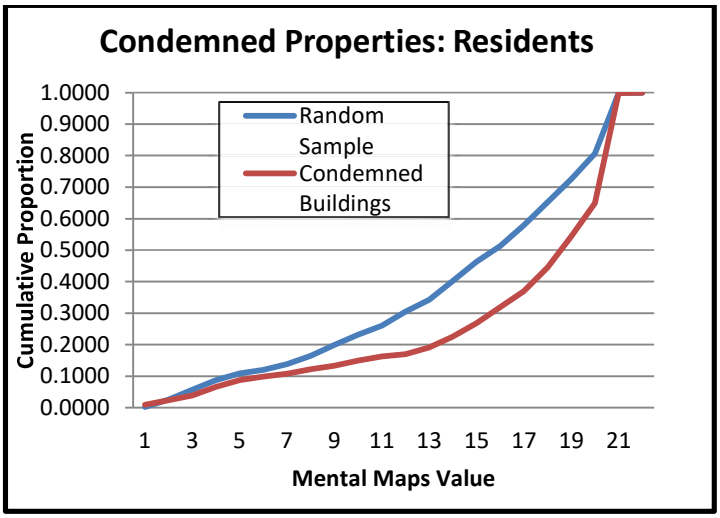
Figure 7B. COS based on mental maps from all 150 participants.

Kolmogorov-Smirnov Test (K-S Test): A Test for Statistical Significance

The examination of both the analysis and maps showed that there are differences between the formal (MHC) and informal (COS) measures of deterioration in the Tripoli The Old City of Tripoli. Beyond this, the K-S test was used to determine if the location of condemned properties was spatially correlated to the COS maps (Smirnov 1948; Sinard and L'Ecuyer 2011). The K-S test is a nonparametric test for the equality of continuous, one-dimensional probability distributions that can be used to compare a sample with a reference probability distribution (one-sample K–S test), or to compare two samples (two-sample K–S test). It works by comparing the cumulative proportion distributions of the groups and does not account for any matching or pairing (Gould 1975, 143). The KS

test tries to determine if two datasets differ significantly and it has the advantage of making no assumption about the distribution of data. The two-sample K-S test is considered one of the most useful methods for comparing two samples because it is sensitive to differences in both location and shape of the empirical cumulative distribution functions of the two samples (Benedict 2014).

As its name suggests, the two-sample K-S test requires two samples (one a study sample and the other a control sample) along with values for a common variable connected to each sample. For this study, the common variable values were supplied by the COS of the various groupings of survey participants. The study sample was the geometric centroid of each of the 436 condemned properties from the MHC maps. For the control sample, the researcher created 1000 random point locations.



In Table 2, the final column contains the K-S statistic (the largest difference between samples) and the probability that this difference occurred randomly. Note that

the probability in all cases is smaller than 0.000 percent. This indicates that there is virtually no chance that the distribution is random, and that the difference between the MHC condemned properties and the random sample is statistically significant.

Table 2. Summary and two-sample K-S statistics for the study sample and the random sample in the Tripoli The Old City of Tripoli.

Variable	Mean	Median	Standard Deviation	K/S Statistic & Probability
Residents' COS				
Random Sample	40.539	45	17.18173	0.211
Condemned Properties	46.6009	53	16.3732	0.000
Former Residents' COS				
Random Sample	11.565	12	5.009078	0.219
MHC Condemned Properties	13.5596	16	4.5807	0.000
MHC Employees' COS				
Random Sample	8.9700	9	0.021	0.259
MHC Condemned Properties	9.9977	11	2.644012	0.000
ECO Employees' COS				
Random Sample	8.87	9	5.746836	0.243
MHC Condemned Properties	11.548	14	5.709	0.000
All Participants' COS				
Random Sample	69.9440	75	29.37035	0.235
MHC Condemned Properties	81.7041	94	28.46231	0.000

Even though there are visual and statistical differences between the MHC and COS, the cumulative proportion graphs indicate that there is general, if not specific agreement about the location of condemned properties.

The analysis was used to identify and compare perceived deterioration of the different quarters in The Old City of Tripoli based on the COS against the percent of condemned properties in each quarter based on the MHC survey and map. These statistics were used to rank the different neighborhoods. These rankings were not completely consistent among the different informant groups, but were close enough to inspire confidence that they did represent similar opinions across a spectrum of informants in the survey.

This consistency makes it possible to say that across all groups of informant's significant differences existed between the rankings based on the COS and MHC maps. In the MHC map, Alhara Elkebera is the neighborhood with the most condemned properties, but the COS consistently ranked that neighborhood as having the least condemned properties. At the same time, COS maps consistently ranked Koshet Alsafar as the quarter with the highest level of deterioration, while the MHC map revealed that only 10 percent of this quarter was condemned—second lowest of the six quarters. Of particular interest is that the MHC employees, the agency that carried out the survey and made the MHC map, were just as wrong as everybody else about these quarters. This indicates that there are deep-seated perceptions about the condition of the different

quarters in The Old City of Tripoli, perceptions that are often at odds with the actual distribution of condemned properties within the neighborhoods.

Kolmogorov/Smirnov (K-S) Test and Cumulative Proportion Graphs

This study used a K-S test to determine whether the location of condemned properties was spatially correlated to the COS maps. This test compared the values of the COS maps at the locations of the condemned properties to values at random locations throughout the Old City of Tripoli. For each COS map the difference between the two samples was statistically significant. This indicated that there was spatial correlation between the COS maps and the condemned properties.

Because the K-S test is based on cumulative proportions, graphs of these proportions were created. In every case, the cumulative proportion of condemned properties was to the right of the random sample, indicating that the COS values for condemned properties were higher than would be expected if they were randomly distributed. This indicates that despite visual differences (Figures 7A, 7B, 9C, 9D and 9E) and differences between summary statistics (Tables 1, 2 and 3), there are statistically significant similarities between the condemned properties from the MHC map and the values in the COS maps. These results indicate that perceived deterioration in The Old City of Tripoli is more complex than simple summary statistics indicated—with both agreement and disagreement between qualitative and quantitative data for condemned properties.

The methodology followed in this study, using mental maps and COS, allows planners to integrate both similarities and differences between the MHC and COS maps. These differences and similarities are not necessarily contradictory but likely represent the difference between lower resolution (The Old City of Tripoli and K–S test) and higher resolution (the quarters and the summary statistics) data and analyses. At lower resolution, the K–S test indicates a positive correlation between higher levels of perceived deterioration and the larger number of condemned properties within the western portion of The Old City of Tripoli. When zooming in to view these data at a neighborhood scale, significant differences are readily apparent between perceived deterioration and counts of condemned properties.

These different results, between high- and low-resolution data, highlighted by the statistical summaries and the K–S test, show the importance of involving stakeholders in the planning process. They underscore areas of agreement and disagreement between the local planners (MHC) and local inhabitants (COS); providing a structure for directed discussions about strategies for restoring The Old City of Tripoli.

Although largely successful as a methodology, there are a couple of areas of concern. First, the lack of precision with which informants marked the maps meant that the COS were better at identifying general (low resolution) trends than specific (high resolution) issues. This may have been due to the small scale of the map sheets. The A4 sized sheet left little room for making fine distinctions within or between

neighborhoods. Landmark buildings, gates, and roads were included in the maps to help informants orient themselves, but they did not seem to have any real effect on the issue of precision. Polygons encompassing multiple neighborhoods were more common than small, intra-neighborhood polygons.

Another drawback to this approach relates to the time necessary to conduct the map interviews. Organizing and conducting interviews was helped by several factors: The surveys were carried out following the 2011 revolution and most residents thought that the survey was part of the new government's work to conserve The Old City of Tripoli and to improve the residents' economic life. Eager to help, many people volunteered themselves and their neighbors to participate. In addition, the researcher received help from the planning agencies that allowed group interviews at their offices. Finally, the Former Residents Society worked to provide contacts among their members and the researcher. Still, the interview process represents a significant amount of time. In this study the researcher worked seven hours a day, six days a week, for two months to organize and conduct the 150 interviews.

Conclusion

Incorporating the opinions of stakeholders is a challenge for urban planners, particularly when neighborhoods and buildings are important to the history of an entire country. Neglected areas need to be conserved not only for historic reasons but also in order for people to continue living there in a healthy and safe way. It is important to find

a method to incorporate public opinion in the planning process. Instead of making plans without the residents' opinions, the planners' work must be informed by public attitudes and perceptions. This research was an attempt to develop a methodology to measure consensus and provide a structure for incorporating stakeholder opinion in the planning process. It used The Old City of Tripoli in as its test case, comparing cumulative opinion about urban decay to a quantitative survey of condemned properties.

Other researchers have studied The Old City of Tripoli from historical and architectural points of view but this work is the first time that geospatial technology has been applied to the Tripoli The Old City of Tripoli. The creation of cumulative opinion surfaces, visual examination of spatial data, along with neighborhood-based summary statistics and the K-S statistical test will enable Libyan planners to better understand stakeholder perceptions of The Old City of Tripoli and to work with them as they begin restoring the deteriorated areas of The Old City of Tripoli. To understand the physical aspects of the city, it is necessary to understand what people think about it. This researcher hopes that the methods used and the conclusions gained from this study will also be useful to other cities with similar challenges to help them build a framework for including stakeholders in their efforts to preserve their cities.

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