Article

Cartographical digital products: Maps, 3D models, diagrams

Efthymios Spyridon Georgiou

Company Efthymios Georgiou, 11741 Athens, Greece; efthimios_georgiou@yahoo.gr

Abstract: The current paper aims at spatial presentation in Cinque Terre. The purpose is to reconstruct digital products (maps, statistics, diagrams, 3D models) and the spatial analysis of the five villages. The goals are the presentation of the geomorphology, geography, population, density, and area. Also, the Strength-Weakness-Opportunities-Threats (SWOT) analysis creates the region disadvantages advantages of the five villages. The methodology is based on the software (G.I.S Pro, QGIS, Zephyr 3D, Microsoft Excel, Generic Mapping Tool) and the bibliography study. For instance, the construction 3D terrain model shows the buildings, roads, green areas, and land cover of the five villages. The digital products help better "reading" the region and emphasize the measurements and location of the region's elements. The final results contain a message about new technologies and spatial planning. The new technologies have given spatial solutions in the last few years. The innovative, understanding, attractive cartographical digital products present the geomorphology of the traditional villages in Cinque Terre.

Keywords: maps; SWOT; geography; 3D terrain; statistics

1. Introduction

The current paper aims to construct cartographical products. Each digital product is an index and way measurement of the spatial analysis. For instance, the full paper suggests recommendations about the usefulness of maps, diagrams, and 3D Terrain in better understanding the region of Cinque Terre.

The digital urban solutions are summarized in the following points:

Recommendation 1: Understanding the methods and techniques to construct digital products. The digital era is a new reality. There are significant benefits to creating cartographical products (maps, diagrams, figures, tables, and 3D models). The products need to be created in an attractive and innovative way.

Recommendation 2: The Cinque Terre region analysis is a mosaic of political analysis and decisions, stakeholders, the law frame, geography, and strategic long-term planning. The final result is the SWOT analysis of the Cinque Terre's strengths and weaknesses. This table helps make policies and configure urban and political planning for the future.

Recommendation 3: It is understanding the usefulness and significance of digital products and era in better urban planning. The digital era offers new opportunities for making political-regional decisions. For instance, the distance observation of the mountains, sea, and geomorphology is a crucial index. This index helps in measurements of distance, length, and polygonal area. Also, it answers the question of the most suitable place for opening tourist activities. The nice panoramic view, the slope of the ground, and the nearby activities are criteria for better urban and environmental decisions.

2. Region analysis

2.1. Cultural heritage and democracy

Cultural heritage management is crucial because strategic planning creates long-term benefits for the sites. When making decisions, one must prioritize priorities, advantages, and disadvantages. Also, the multi-participation of organizations, companies, institutions, government sectors, and universities is the optimistic direction for successful management. Democracy is for all. The protection, preservation, documentation, and promotion are the responsibility of the governance and level of citizens.

Nowadays, culture is an ecumenical term. The exchange of ideas, opinions, recommendations, and practice experience obtains the framework. Sometimes, the acceptance of democratic rules is an influential factor in success. For instance, cyclical and balanced economic development benefits all people. The level of satisfaction and sustainability is the biggest. To summarize, the vision of one better planet goes together with cultural heritage protection.

2.2. Cultural heritage in Cinque Terre

Cinque Terre National Park is one of Italy's most valuable destinations for tourists worldwide. In addition, the park, inscribed on the World Heritage List as a cultural landscape, is an essential source of values that must be protected and exploited [1]. The site was added to the World Heritage List as a cultural landscape in 1997, and the Cinque Terre National Park was established in 1999 [2]. The management plan developed for this area needs to deal with different issues: abandonment of terraced cultivations and growth of secondary forests, hydrogeological risk, and high touristic pressure [3].

Recently, many Mediterranean cities have occasionally exceeded their carrying capacity, compromising their natural/urban environment, lifestyle, and cultural traditions [4]. Public participation is increasingly important in the decision-making process for incorporating the ideas and the needs of the local communities, helping to find effective solutions for valorizing historic landscapes and improving the quality of life [3].

2.3. Environmental heritage in Cinque Terre

The link between environmental strategy and firm performance may be affected by the managers' interpretation of the environment, that is, by their opinions about the opportunities and threats linked to the environment within the framework of the environmental strategy [4].

This management needs to be systematic, reflexive, and cyclic to use multiple views and methods for an environmental management problem [5]. The management needs to emphasize the planning and the results. His measurements are significant tools for successful management. His indexes lead to the best solutions and a better understanding of the situations.

3. Region analysis

3.1. Geography

Tables 1–3 present the area, perimeter, population, density, and coordinates in Riomaggiore, Manarola, Corniglia, and Vernazza. The five traditional villages are unique destinations. The natural beauty and the geography have great benefits.

Table 1. Geography units Riomaggiore and Manarola [6–8].

	Riomaggiore	**Manarola**
Population	1332	No available
Coordinates	44°06′N 09°45′E	44°06′23″N 9°43′41″E
Average elevation	250 m	161 m

Table 2. Geography units Corniglia, Corniglia, Vernazza [6,9,10].

	Corniglia	**Vernazza**
Population	No available	730
Coordinates	44°7′10″N 9°43′00″E	44°08′N 09°41′E
Average elevation	180 m	255 m

Table 3. Geography units Monterosso al Mare [6,11].

	Monterosso al Mare
Population	1340
Coordinates	44°08′45″N 09°39′15″E
Elevation	186 m

3.2. Scenario planning

The SWOT analysis examines four factors of the Cinque Terre. Tourism, culture, environment, and geography. SWOT analysis in Cinque Terre sometimes offers a better "reading" and governance of the situation. Every politician, urban planner, cartographer, and governor sector needs to make decisions. The decisions are very significant for the future. The purpose of this chapter is to examine the use of the strategic management tool, Strength-Weaknesses-Opportunities-Threats or SWOT analysis [12]. The SWOT analysis guidelines derived from contemporary strategic management theory, especially the resource-based view of the firm [13]. SWOT analysis may also have applications within appreciative inquiry, benchmarking, industry analysis, situation analysis, and scenario planning [14].

The protection of the planet has a crucial meaning nowadays. Society changes because technology goes forward. The economic-environment makes the cycle of life. The modern era needs "smart" and green solutions. For instance, cultural heritage includes buildings, routes, museums, and intangible and tangible cultural heritage. For example, the history of the places and the songs need to be shared and preserved by the new generation.

In other words, ne-classism buildings have the same goals: Preservation, protection, and documentation because they offer income to inhabitants. Also, the

historical places are part of the history of Italy. Making decisions is always significant for successful management. Social-technology conditions depend on age, gender, education level, and business environment. Also, the economic and environmental situation has significant meaning nowadays, such as the European green transformation. Preservation, protection, and alternative energy are the main pillars nowadays. **Table 4** shows the Strong-Weakness-Opportunities-Threats in region in Cinque Terre. The demography is sometimes presented as maps, graphs, tables, and data modeling. Visualizing demography is excellent because it constructs attractive and innovative digital products. Our year's digital transformation is a reality. The new technologies build intelligent products.

Table 4. SWOT analysis [15–17].

SWOT				
	Strong	**Weakness**	**Opportunities**	**Threats**
Tourism	Tourism philosophy	Protect flora and fauna	Need management planning in person, local, governance level	Overpopulation sometimes
Culture	UNESCO world cultural heritage	Continuous care	Sharing the history	Preservation of Buildings
Environment	Protected areas	Need more business persons	New technologies	Fires, flows
Geography	Strategic location	Huge slope in villages	International cooperations	

4. Digital products

4.1. Generic mapping tools

The construction digital elevation model or DEM in Italy has requirements for the following things. Firstly, the author creates the color bar relative to the topography theme of the earth. For instance, the low elevation is green because it represents the alleys. The sea is blue, the high mountains are maroon, and the high mountain peaks are white. The GMT or Generic Mapping Tools is a tool that creates modern, "smart," and innovative solutions. The commands can be searched on the website,generic-mapping-tools.org [18]. It is a free and open-source software. Since GMT classic mode has existed for 30 years. I participated in InSar Processing and Theory with GMTSAR short course, which it organized by Earth Scope Consortium [19]. The GMT toolbox includes about various and varied core and supplemental program modules sharing a common set of command options, file structures, and documentation [20]. The Generic Mapping Tools progress base on 3 pillars:

- Generic Mapping Tools installation.
- Import GMT Color Bar.
- Import GMT Earth Relief (Coordinates Latitude, Longitude).

Figures 1–3 shows the region in Cinque Terre. The coordinates are from 8′00″ to 11′00″ East and from 43′00″ to 45′00″ North. The location is near the sea and mountains. Also, there are a few alleys parallel the coastline.

DEM Italy

```
gmt begin GMT_tut_16
 gmt set GMT_THEME cookbook
     gmt     fig.colorbar(frame=["a1000",
"x+lElevation", "y+lm"]
gmt     grdimage     @earth_relief_30s–
R5/20/32/45 –
I+a100+ne0.8 -JM6i -B -BWSnE
 gmt colorbar -DJTC -I0.4 -Bxa -By+lm
gmt end show
```
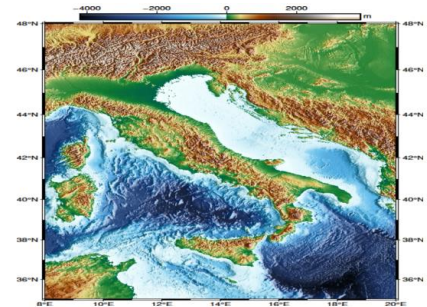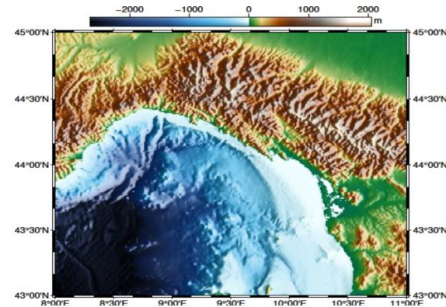

Figure 1. GTM Italy [18].

DEM Cinque Terre

```
gmt begin GMT_tut_16
       gmt set GMT_THEME cookbook
       gmt fig.colorbar(frame=["a1000",
"x+lElevation", "y+lm"]
       gmt grdimage @earth_relief_30s
–R8/11/43/45 –I+a100+ne0.8 -JM6i -B
 -BWSnE
          gmt colorbar -DJTC -I0.4 -Bxa -
By+lm
gmt end show
```


Figure 2. DEM Cinque Terre [18].

```
gmt begin GMT_tut_16
       gmt set GMT_THEME cookbook
    gmt fig.colorbar(frame=["a1000",
"x+lElevation", "y+lm"]
       gmt grdimage @earth_relief_30s
–R8/11/44/45 –I+a100+ne0.8 -JM6i -B
 -BWSnE
          gmt colorbar -DJTC -I0.4 -Bxa -
By+lm
gmt end show
```
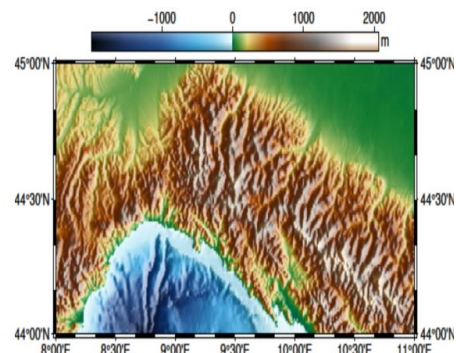

Figure 3. DEM Cinque [18].

The specialized flora of serpentine outcrops in Tuscany (Italy) is analyzed in terms of species richness and geographic variation to identify major centers of diversity and provide a basis for conservation programs [21]. Due to a centuries-old agricultural practice, the coastal landscape of the Cinque Terre (eastern Liguria, northwestern Italy) has been almost completely modified by terracing the slopes by reworking millions of cubic meters covered in rubble and the construction of thousands of kilometers of dry stone walls [22].

4.2. Maps

Figures 4 and **5** show the maps from Cinque Terre. In the region, there are five traditional villages with unique natural beauty. The map presents the location and the photos from the Riomaggiore, Manarola, Corniglia, Vernazza, and Monterosso. Also, the map contains the scale bar and the symbol North. The map product is scaled at 1:50.000. The orange points show the location of each village. The coastline is the Ligurian Sea.

Figure 4. The location in Cinque Terre [23].

Figure 5. Location in Cinque Terre in Europe [23].

Cinque Terre—UNESCO world heritage site

Figure 5 shows the region of Cinque Terre in the orange cycle. The five most beautiful villages in Italy are in Western-North Italy. The map contains the Symbol North, the Scale bar, and the topographical basement. The coastline, the five villages, and the surrounding hillsides are all part of the Cinque Terre National Park, a UNESCO World Heritage Site. Vernazza is a member of the I Borghi più belli d'Italia ("The most beautiful villages of Italy") association [24].
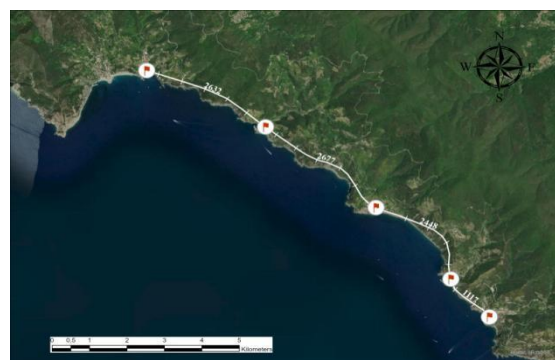
Figure 6. The train distance in Cinque Terre [25].

Figure 6 shows the train stations and the distance of each village. The total distance is 8.870 meters. The mean distance is (total distance/four measurements) due to the shapefile (**Figure 6**) is ≈ 2217.5 m. There are five train stations in each

village. **Figure 7** presents the elevation of every village. Vernazza (255 m) and Riomaggiore (250 m) have the highest elevations. Manarola has the lowest elevation of the five villages, at 161 m.

Figure 7. The elevation in Cinque Terre [25].

In the villages of Cinque Terre, the visitors meet the "green" and "blue." The train system between the villages is significant. Each village has something unique. The Monterosso al Mar has fantastic coastlines and mar, the Vernazza has romantic sunshine and quiet shops, the Corniglia is located at a high elevation, Monterosso likes a cart postal, and Riomaggiore is a fish's village. The conditions in the villages of Cinque Terre are the environmental conditions, the fresh air, the sound of the waves, and the vision without cars. The name comes from the geography itself because there are five traditional villages. **Figures 8–12** are screenshots from Google Earth [26]. It configures the angle, and the camera zooms in on every village. There are various and varied ways to export screenshots. Each photo presents the details from the area. Also, it is possible to configure each photo's contrast, brightness, and dpi.

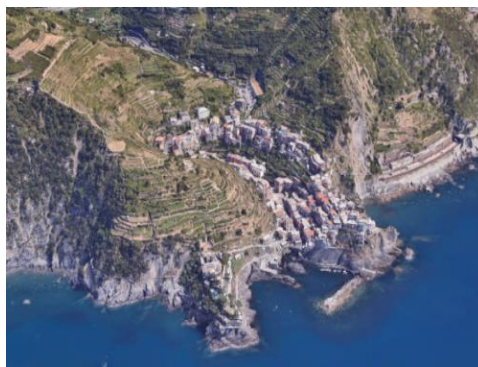**Figure 8.** The location from RioMaggiore [26].

Figure 9. The location from Manarola [26].

Figure 10. The location from Cornilia, from Manarola [26].

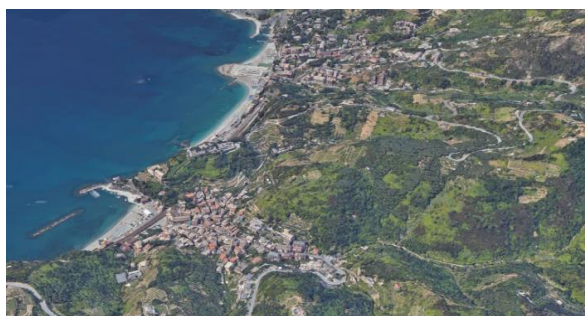**Figure 11.** The location from Vernazza, from Manarola [26].

Figure 12. The location from Monterosso al Mar, from Manarola [26].

4.3. 3D Terrain

Figure 13 shows the steps of the project. It is significant to use Google Earth and Zephyr 3DF [27]. Google Earth has enough quality 3D aerial images. The author

takes 20–25 screenshots for each village. The photos cover the spherical villages. The process is a part of a photogrammetric function because of the purpose of the 3D Terrain cutch with the software 3DF Zephyr.
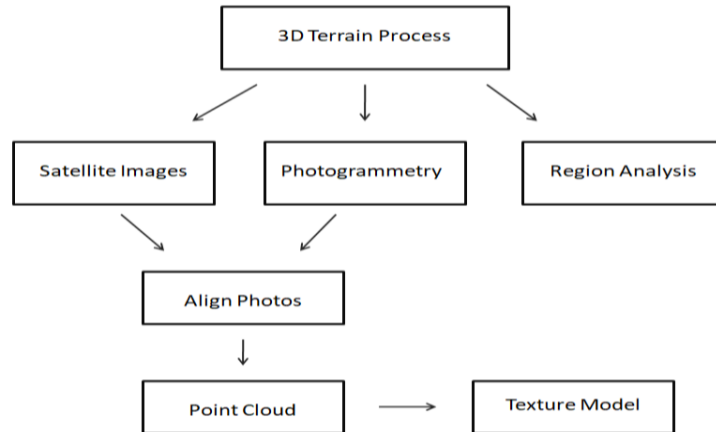

Figure 13. Data modeling the process.

The 3D aerial photos align with the 3DF Zephyr software. The steps are simple, understandable, and intelligent. There is an Italian tradition around the design of products. Italian programmers and planners are famous because they have the philosophy to create new products. The final results (**Figure 14)** present the five beautiful villages. The texture model can rotate, cut areas, and zoom out/in. Also, the products are sometimes present on online platforms and stored in various formats.
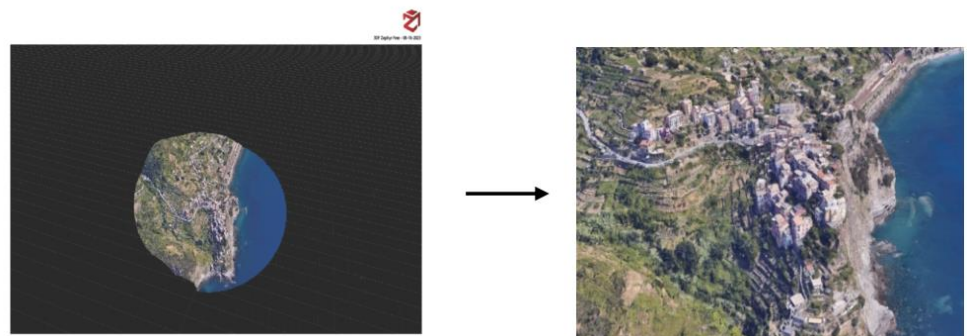

Figure 14. Photos and 3D model.

The 3D Model allows the terrain analysis and observations of the villages. Many times scientific results export with digital way, because the pedestrian observation in the field work hasn't effective. For instance, the slope of the ground is useful measurement, because it helps in the conditions of the walking roads and the buildings preservation. The following **Figures 15–19** show the view of the villages. The texture models present in the **Figures 15–19**. The platformplaycanvas [28]. The modern time needs modern solutions. Also, in the platform sketchfab.com [29] shows the 3D view of the five traditional villages in Cinque Terre.
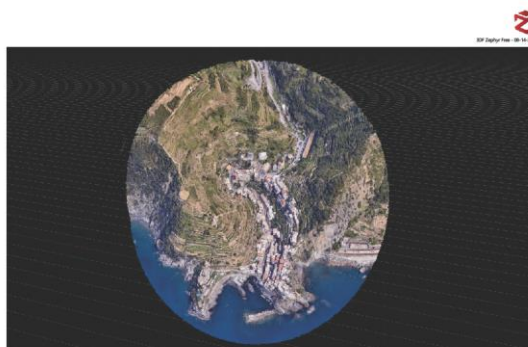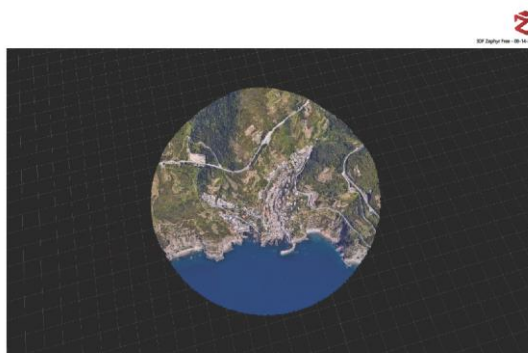
Figure 15. 3D Terrain from Manarola [30].

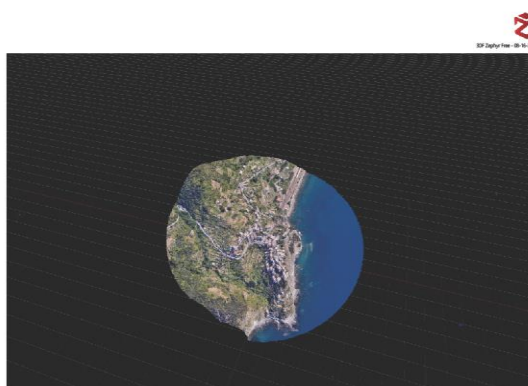**Figure 16.** 3D Terrain from Riomaggiore [31].

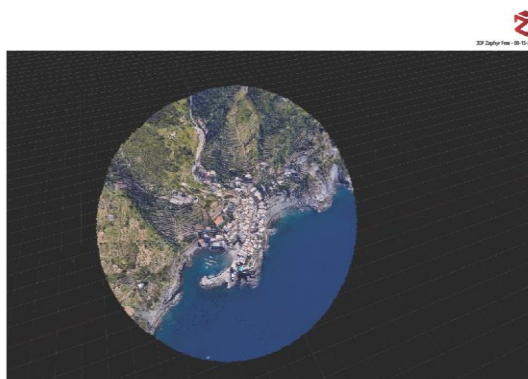**Figure 17.** 3D Terrain from Corniglia [32].

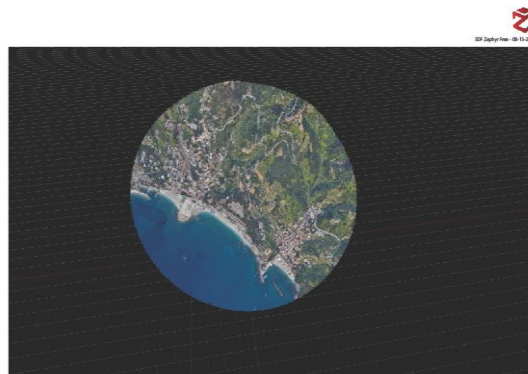**Figure 18.** 3D Terrain from Vernazza [33].

Figure 19. 3D Terrain from Monterosso al Mare [34].

5. Conclusion

The current paper is an individual effort. The work objectives are the visualization and spatial analysis in Cinque Terre. The manuscript describes the maps, statistics, graphs, DEM, and 3D Terrains. The new technologies offer modern solutions. In the final years, technological tools grow. This fact helps in a better study of the regions. For example, in the previous 20 years, visitors traveled to cities with analogical maps. Archeology works with maps and traditional measurements. Nowadays, digital products emphasize accuracy and authenticity in regions. Also, spatial, environmental, and cultural management is crucial for success.

Conflict of interest: The author declares no conflict of interest.

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