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Techniques for drawing and mapping a Cultural Route

The idea for the development of this paper came from the chance of a lecture that was requested to be given and which referred to the topic of drawing, charting, and mapping a cultural route. Looking for additional published material at the international level, it was observed that at the technical level (that is, the drawing of a cultural route from a technical point of view); there was a huge gap, with almost non-existent literature. At the same time, it was observed that many students were not ready to identify and choose an appropriate method to use when the time came to draw up a cultural thematic route. The main objective of this paper is to fill this educational gap by proposing a methodological approach that could be followed, from a technical point of view, to draw a cultural route through topography and spatial analysis.

Keywords: Cultural Routes, Drawing Techniques, Mapping Techniques, Cultural Heritage, Cultural Topography

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Introduction

A typical example that in recent years has contributed to both the dissemination and the preservation of Cultural Heritage is the so-called Cultural Routes, which are inextricably linked to both Digital Cartography and what is now called Cultural Informatics. Nowadays, if someone searches for additional literature on the drawing of a Cultural Route on a technical level, he will find a huge gap and almost non-existent literature. The need to fill this educational gap is the main objective of this paper, which reports and proposes the methodological approach to be followed from a technical point of view for mapping a Cultural Route through topography and spatial analysis techniques.

By definition, themed routes are tourism products that associate a selected theme with natural and created attractions that can be reached by a variety of means of transport (Puczkó & Rátz, 2000). Taking the principle of sustainability into account, these routes offer opportunities to gather information, have fun, and relax simultaneously. A cultural route is a themed route that has a cultural value or an element of cultural heritage as its focus and that assigns a key role to cultural attractions (Puczkó & Rátz, 2007).

The international scientific CIIC-ICOMOS Committee defines cultural routes in its draft of the international charter on cultural routes (2003):

"Any route of communication, be it land, water, or some other type, which is physically delimited and also characterized by having its own specific dynamic and historic functionality, which must fulfill the following conditions: It must arise from and reflect interactive movements of people as well as multi-dimensional, continuous, and reciprocal exchanges of goods, ideas, knowledge and values between peoples, countries, regions, or continents over significant periods of time. It must have thereby promoted a

cross-fertilization of the affected cultures in space and time, as reflected both in their tangible and intangible heritage".

Now, when we talk about routes in general and how we draw them on paper or the computer, we are technically talking about lines that connect two or more points, the so-called stations of that route. All this drawing is a field of knowledge in the science of discrete mathematics, also known as graph theory (Hsu & Lin, 2009).

The term graph can refer to two completely different things. Students usually first learn about a graph as a plot, function, or function graph. Here we refer to a different definition of a graph, in which a graph is another word for a network: a set of connected objects (called vertices or nodes). The connections between nodes are called edges or links.

When the edges in a graph are directed, i.e., point in only one direction, the graph is called a directed graph, or sometimes a digraph for short (Sugiyama & Eades, 1990). When drawing a directed graph, the edges are usually drawn as arrows indicating the direction, as shown in the first figure below (Figure 1). If all edges are bidirectional or undirected, the graph is undirected, as shown in the second figure (Figure 2).

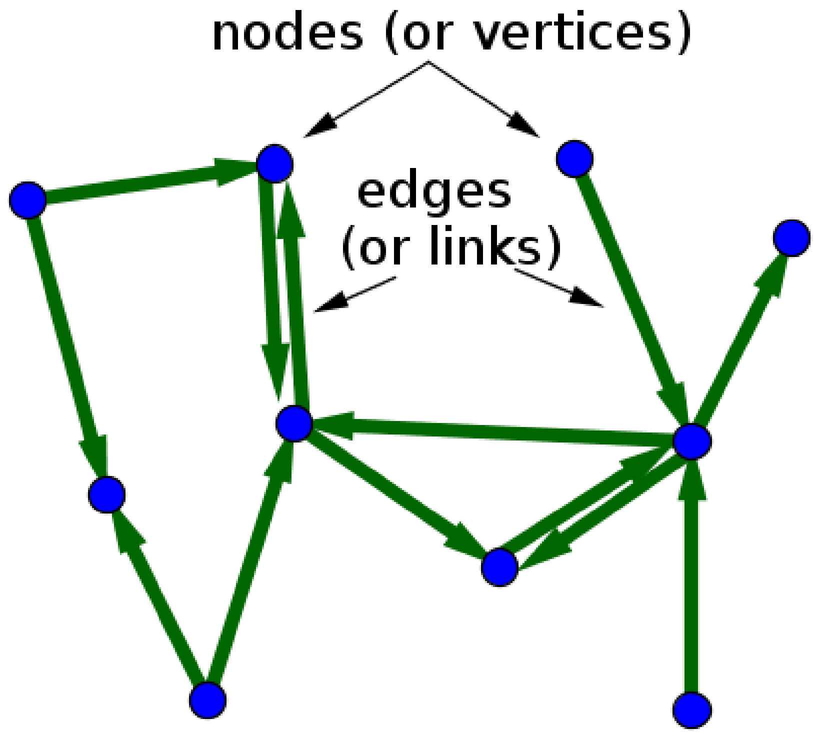

Figure 1: A directed network with ten nodes (or vertices) and 13 edges (or links). When two nodes are connected in both directions, we count the connections as two edges. [Source: Nykamp DQ].

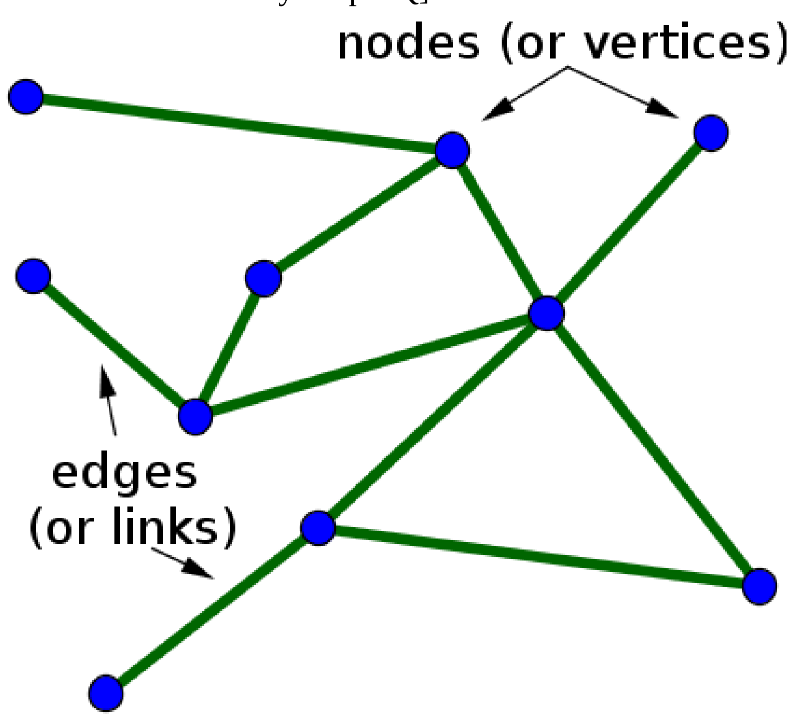

Figure 2: An undirected network with ten nodes (or vertices) and 11 edges (or links). Source: Nykamp DQ,

Graph theory, an interdisciplinary approach.

The abovementioned theory has applications in many sciences, so we can easily understand how it is directly related to them, such as mathematics, computer science, spatial planning, topography, transportation science, and engineering.

However, apart from these cases, graph theory is also being developed in other sciences such as chemistry, physics, psychology, and sociology. It is striking that there are no clear boundaries between where the graph theory ends and where it begins. Thus, the importance of this theory is enormous because it strengthens the concept of interdisciplinarity to the highest level (Cai et al., 2018; Goyal & Ferrara, 2018).

Now, if we adapt graph theory to the route drawing we focus on in this paper, it will not be something random, something arbitrary in space, as would be the case, for example, in a computer network (Hart, 2013; Sasireka and Kishore, 2014). In such a case, it is obvious that we would not care exactly about the location of each central computer unit, but we would want to know, for example, that there are five computers in a row, as shown in the following figure (Figure 3).

However, if we are referring to any type of route and even more so to planning a route, then we are concerned with the exact points in space that need to be drawn as accurately as possible (Malaperdas & Panoskaltsis, 2022). For example, if we want to connect a route between historical sites in the prefecture of Messenia in southern Greece; that starts from Kalamata, then goes to Pylos, and ends in Kyparissia, we need to know the exact location of these three towns (Figure 4).

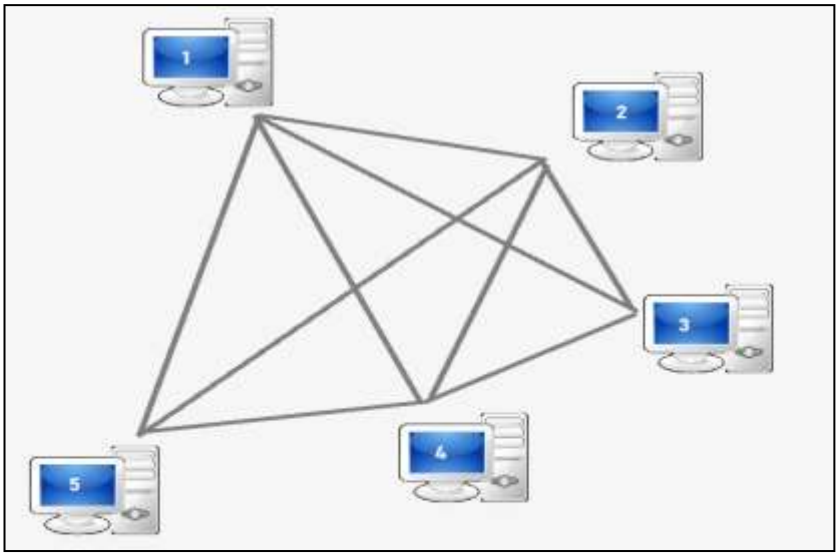

Figure 3: Interpretation of graph theory in terms of relative location in the case of computer science.

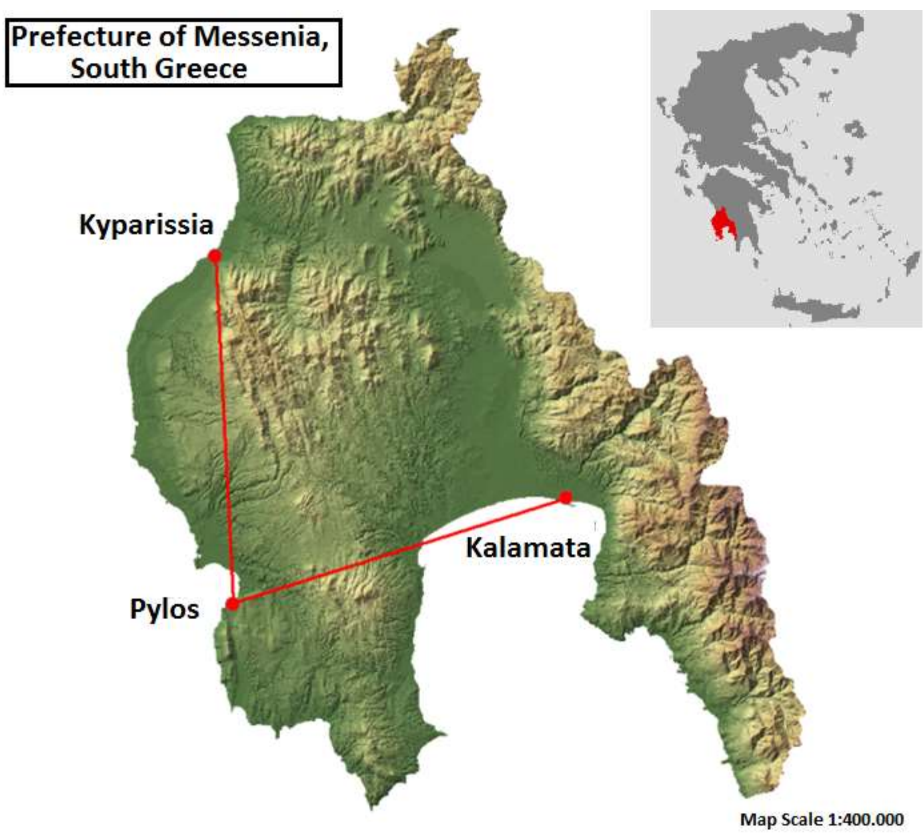

Figure 4: Interpretation of graph theory in terms of precise location in the case of route planning.

In this case, it is necessary to use the corresponding theorem of graphs which can be found in topographic methods and mainly concerns the analysis of networks (Murdoch,1999). This theory is also known as “network theory” (Demšar et al., 2008).

About edges, nodes, and other key concepts

Since this work deals with scientific fields other than engineering, a case study was created to easily understand the basic definitions needed in linear data mapping cases. Figure 5 shows a map of the Attica Metro of Athens, which was selected as a case study (Figure 5).

On the map, apart from the numbering, all the different routes are designed in a different color to stand out from each other and be more easily perceived by travelers. It is also obvious that each route is a line and thus symbolized, except in extremely rare cases not discussed in this paper.

Let us say that you follow line 2, in red, from Aghios Antonios station to Omonia station. Each of the stations we meet (Sepolia, Attiki, Larissa Station, Metaxourghio), along with the two stations that are our main question, what is our starting point (Aghios Antonios) and what is the destination (Omonia), and now if we have a design concept, we can see how they are designed, as points. So each station appears as a white dot on the map. This dot is called a “Node” in network theory.

As we have seen, the station that interests me as the beginning of my route (Aghios Antonios) is called the “starting node” (or source node), while the station where I want to end (Omonia) is called the “destination node ." It should be noted at this point that routes, no matter what their character (thematic), whether cultural or simply walking paths, is always dependent on structure and design, can either be only one “starting node” and reach one “destination node," or have several “starting nodes” and several “destination nodes," so that the visitor can enter and exit the route, from several stations.

Any line connecting these nodes is called an “edge” and is essentially the interchange link (that whole red line on the map). A “network” or “network graph” is a collection of nodes connected by lines. In our case, that is the entire map in Figure 5. Finally, two nodes are called “connected” if a route connects them, such as the Sepolia and Panepistimio nodes.

Figure 5: The Attica Metro Map.

Hierarchy of nodes

Although from a mathematical point of view, all the points of a line are equally important, from the point of view of topography or cartography, this is not always considered satisfactory. Since the line describes a phenomenon, some parts of the line often represent particular features while others do not.

For better understanding, let us consider the example of a cultural route connecting two different places at nodes 1 and 4 (Figure 6). It is easy to understand that the main issue for someone who wants to follow this route is precisely these nodes 1 and 4. They will be the starting and the destination nodes. For this reason, in the design phase, nodes 1 and 4 should have the greatest weight of all other nodes.

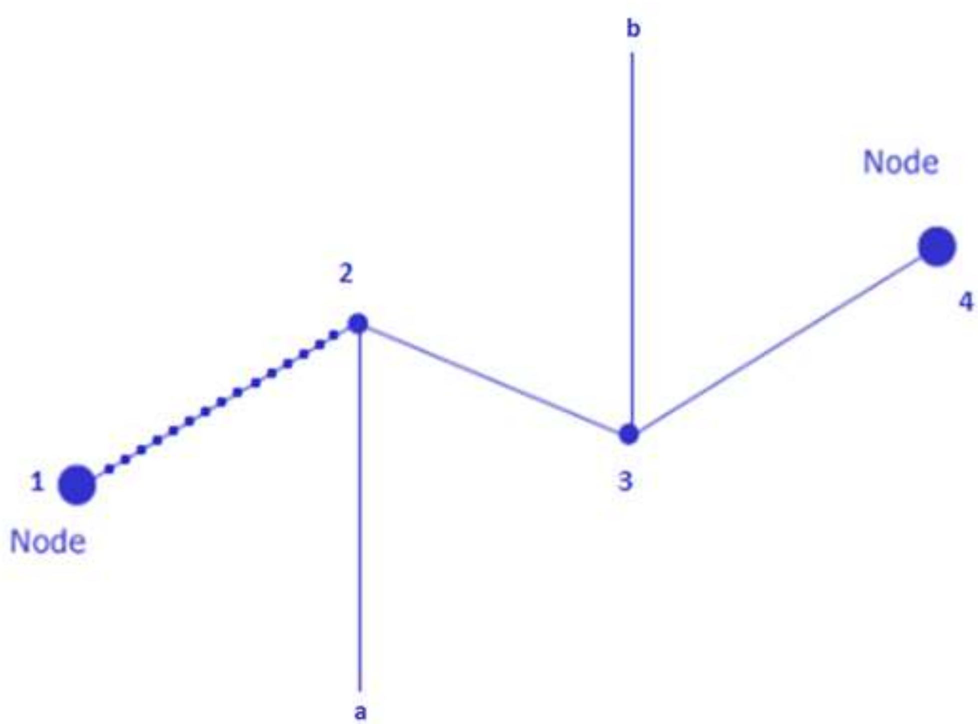

Figure 6: Hierarchy of the nodes plan.

However, along our route, junctions from other minor side roads may be intersections of a major artery with other minor roads (e.g., 2-a node and 3b node). From a cartographic and topographic point of view, these nodes are more important nodes than any other nodes that form a line (e.g., a line 1-2). Here we need to define each line as a sequence of points that, in turn, implement the line so that each line consists of many connected points, as in lines 1-2.

In transportation studies, there is a corresponding terminology that refers to the identification of all important points (nodes). These points are defined as “Very Important Points” (VIP). These important points are identified and interpreted as the points that change the characteristics of the line. Looking at Figure 6 again, points 1 and 4 are the route's starting and destination nodes. There are also nodes 2 and 3 because that is where their meaning changes as intersections occur there.

What must be understood here is that a line consists of many points. At these points, some are important, and others are less important in the design of our route, and all these points should always be given priority.

A distinction of Cultural Routes based on scale

There are many different categorizations of cultural routes, depending on their thematic area, the type of movement, depending on their temporal duration in time, etc. (Kyle et al., 2004; Majdoub, 2010; Oikonomopoulou et al., 2018). Two main distinctions are explored in the study of technical terms:

- The first and most important distinction concerns the scale. Thus, depending on their scale, cultural routes can be divided into:

- *Urban cultural routes, which are limited to the monuments and cultural elements of a city - urban area*
- *Local cultural routes, which focus on a limited geographical unit (e.g., within the boundaries of a municipality or prefecture)*
- *Supra-local cultural routes may cover a much larger geographical area, especially if they are routes with a specific theme.*

- The second distinction mainly concerns the territory covered, and thus cultural routes are divided into national (within a national border) and transnational (in cooperation between two or more countries).

Finally, it should be noted that choosing the most suitable cultural route that fits a territory depends each time on its particular physiognomy and identity. It is also important to say that participating in a cultural element or monument in a cultural route does not exclude the possibility of the same element being included in other cultural routes with a different theme (Mariotti, 2012; Zabbini, 2012). Similarly, a cultural monument or element may simultaneously be part of cultural routes of different scales (Kil et al., 2012; Ganduna and Papagwrgiou, 2012).

Methodology

Having acquired the basic knowledge of the terms and meanings, it is now time to address the methods by which one or more cultural routes are actually drawn. We will now learn about the primary approach engineers, or technicians use to plan and plot a complete route on a map.

Right and wrong ways of mapping a Cultural Route: The methodological approach

Having introduced the basic elements and key definitions, it is now time to move on to practice. Here we will learn about the ways of representing routes from a technical point of view. In simple terms, it is the methodology used by engineers or technicians to draw a complete route on a map or a topographical plan.

By definition, we can say that *"As a mapping of a cultural route, we call the linear union of a series of at least two or more points, called nodes on a map or a diagram."*

In the vast majority of cases where we need to design a cultural route, we will find that almost none of them are just a designed straight line. Many can be identified with an existing road network on a map. Generally, the more nodes used, the more accurate our route mapping will be.

Let us now look at the case study, which was created for the needs of this paper and is given simply so that it can be understood by anyone interested in any scientific field. The cultural route concerns the union of two points, A and B (Figure 7).

Figure 7: Case Study – connection of two points (nodes) A – B.

The satellite image of 2015 shows the area where the castle is located within the town of Pylos (Malaperdas & Panagopoulos, 2021), the so-called Neokastro or Niokastro (Figure 8). We are talking about a castle inside Pylos because, in the wider area of Pylos, there is another historic castle, the so-called Paleokastro (Figure 9).

Figure 8: The castle of Neokastro in Pylos.

Figure 9: The second castle of Pylos, the so-called Paleokastro.

It should be clarified that a more complex solution approach may be required for a complete mapping of the routes in the case considered here. What remains the same, however, are the general principles we will apply.

So let us assume that we want to draw a route on the map from Node A to Node B that will connect. Now if for some reason, you simply draw a straight line connecting Node A to Node B, this is the wrong way to draw a route (Figure 10).

Figure 10: The wrong way to connect the two nodes, A and B.

This is the wrong way in terms of the geometry of the shape because it uses a simple straight line, while it is easy to understand that several smaller lines should be connected and form a polyline (a series of smaller straight lines joined together).

The correct way to draw the route is shown in the following figure, with the many intermediate nodes between the two defined nodes, A and B (Figure 11).

Figure 11: The correct performance of the nodes in the route design

Looking now at Figure 12, it is obvious and quite understandable that the following route geometry is very different and is not simply reflected on a straight line, as was the case in the example of Figure 9.

Regarding naming the nodes, it also has a specific methodological approach. Usually, when a route starts from a node called A, and the destination node is called B; all intermediate nodes are normally named A1, A2, A3, and so on, as in the example of Figure 11.

In other words, we do not use the continuation of the alphabet and the labels for nodes C, D, E, etc., because they refer to a more distant point, discussing the meaning of distance. That is, since the starting node is called A, and the destination node is called B, node C automatically refers to a more distant point than B, even though this may not be the case in reality.

However, apart from the geometry of the shape itself, consider this type of drawing incorrect with respect to another key element, namely the distance of the route. If the distance between nodes A-B is measured in the correct example (Figure 12), it is 209 meters and 30 centimeters. In the example to be avoided in Figure 10, where the distance A-B is drawn in a straight line, the same distance is measured as 207 meters and 27 cm.

In other words, with a distance measurement of about 210 meters, there is a 2-meter discrepancy between our examples. Imagine if this happened at a distance that was not 210 meters but 2100 meters or even 21 kilometers. As you can easily imagine, the difference would be huge.

Figure 12: The correct way to connect the two nodes, A and B.

Route Planning Triangle

The analysis of the above makes it clear that the geometry of the shape of any cultural route is directly related to its distance and the greatest and most reliable information for the visitor. All these compose an information triangle (Malaperdas, 2023), with these three factors mentioned above, which are interdependent, as they directly influence and affect each other (Figure 13).

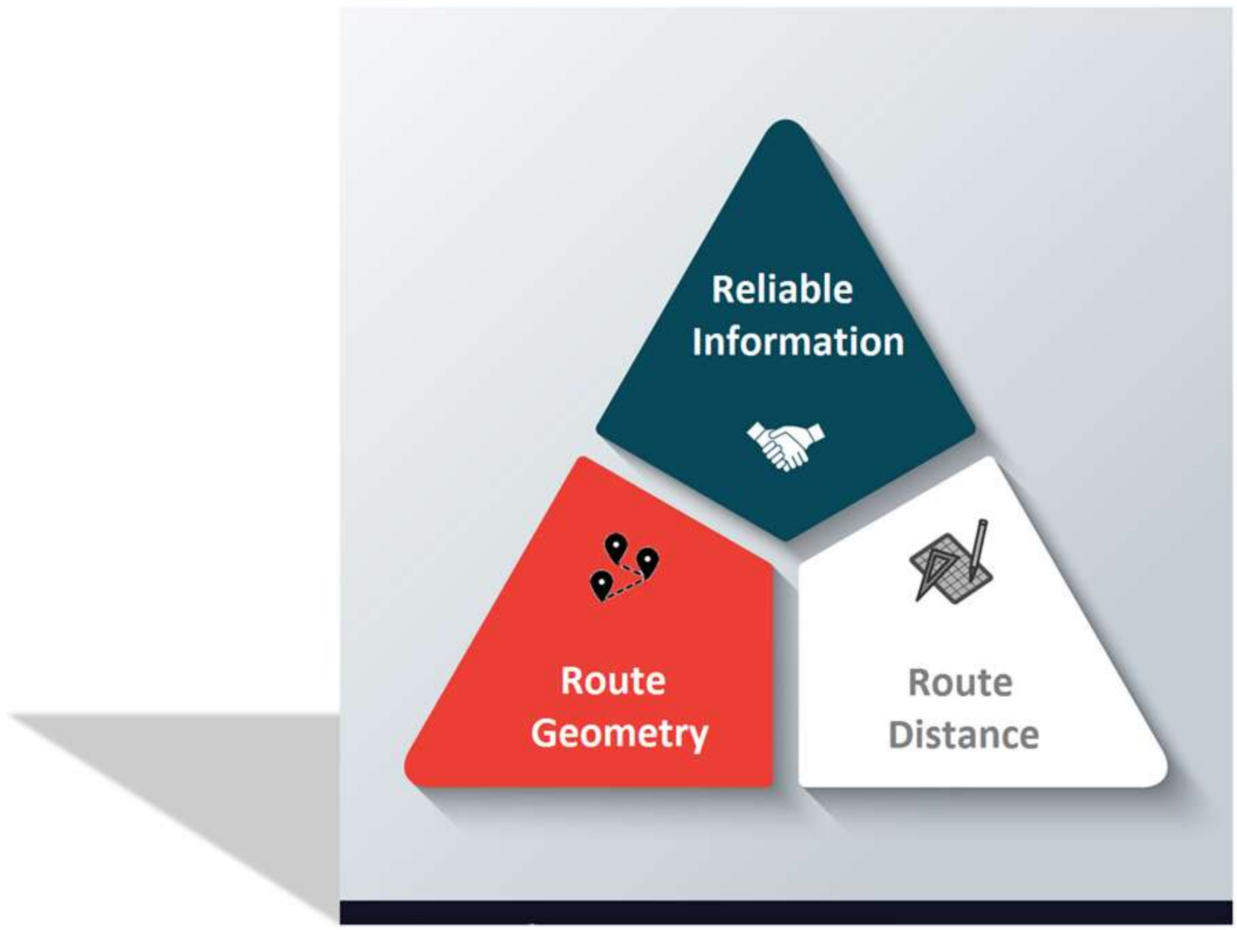

Figure 13: Route Planning Triangle

Drawing stages of a cultural route

The stages of drawing a cultural route can be divided into two main categories, as shown in Figure 14. These stages are:

- ***Office work and***
- ***Fieldwork***

Office work, in turn, is divided into three phases. The first is the preparation of a workshop, in which the people set up the workshop, available equipment, and other supporting materials (papers, pencils, measuring tapes, etc.) so that they are fully equipped for field work and can be processed.

The second phase of the office work is directly related to the fieldwork, as it concerns the basic planning and scheduling of the fieldwork to facilitate the situations and obstacles we will encounter by optimizing the data collection in terms of time and quality (technical).

The third phase of the office work concerns the processing and control of all the data and information collected during the implementation of the fieldwork. This phase includes processing measurements, illustrating topographical diagrams and maps, and preparing technical reports or studies.

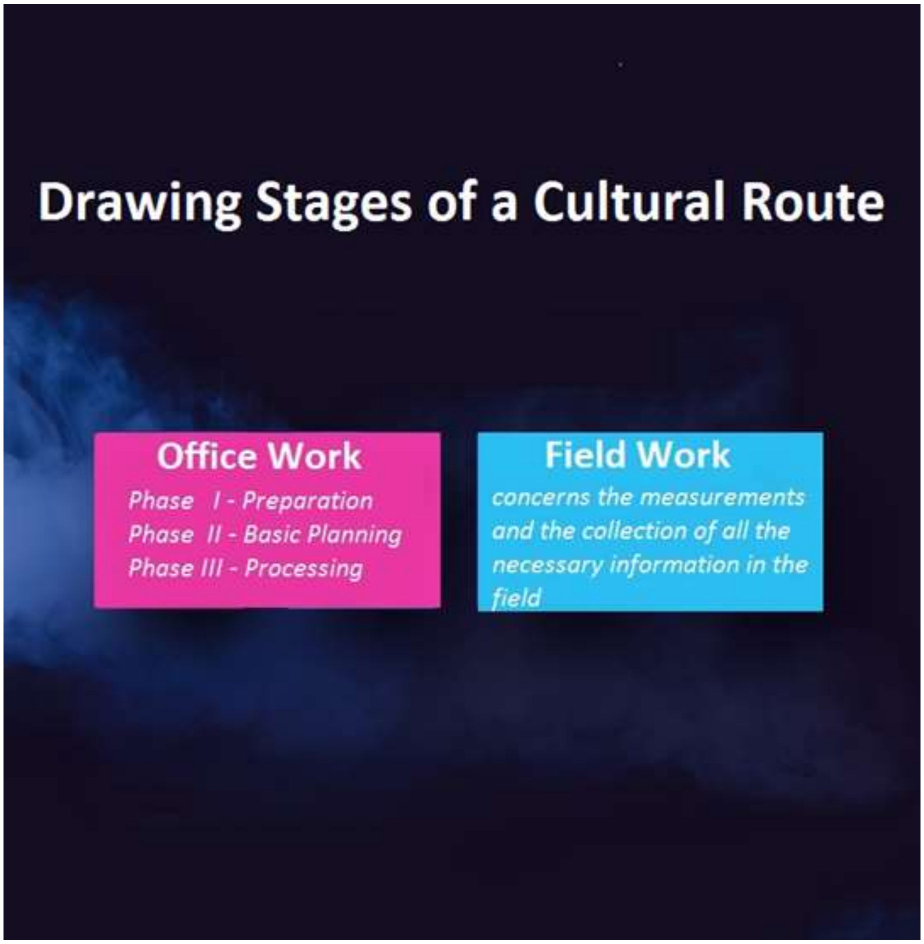

Figure 14: Drawing Stages of a Cultural Route

Technical Information approaches for drawing a cultural route

The methodological approach to drawing a cultural route depends mainly on the resources and data we have at our disposal. There are three main approaches in this direction. The first one is called "Zero point Cad" and concerns the topographic methods used by surveyors when they want to measure relatively short distances. We have neither maps, backgrounds, or satellite images available in these cases. Our only data are the two or more locations we need to survey and define our Cultural Route.

For example, if the goal is to connect two places, the simplest method is to use a GPS to help us in this direction (Malaperdas & Zacharias, 2019; Malaperdas et al., 2022). The method is as follows: We reach the first of the two sites, which will be the initial starting node, and we record the point coordinates. In the meantime, and until we reach the second location, which will be the destination node, we will record points at regular intervals, especially when the geometry of the route changes. For example, if we are following a road, we should record coordinates at intersections with other roads or at points where the straight line we are following appears to end. In this way, we have essentially mapped a new complete route that can be printed on a blank sheet of paper or a blank screen of some design software on a computer.

Figure 15 shows the different phases of work leading up to the final print. The first phase includes recording the coordinates in the field (15a). Figure (15b) shows the result of our measurements and the coordinate table as it will be extracted. In Figure (15c), the coordinate numbers have been replaced by points (positions) in the area, which now define the geometry of the path, while the linear union of all the nodes gives exactly the Cultural Route (15d). In Figure (15e), we add a satellite image of the wider area and use it as a background. We also prioritized the start (A) and destination (T) points of the route as the most important points (VIP points). At the same time, we enlarged them as symbols on the map to highlight them. In general, we have reached the final phase of editing and execution of our cultural route, which we can embellish quite dynamically, depending on the time we spend on its design and illustration.

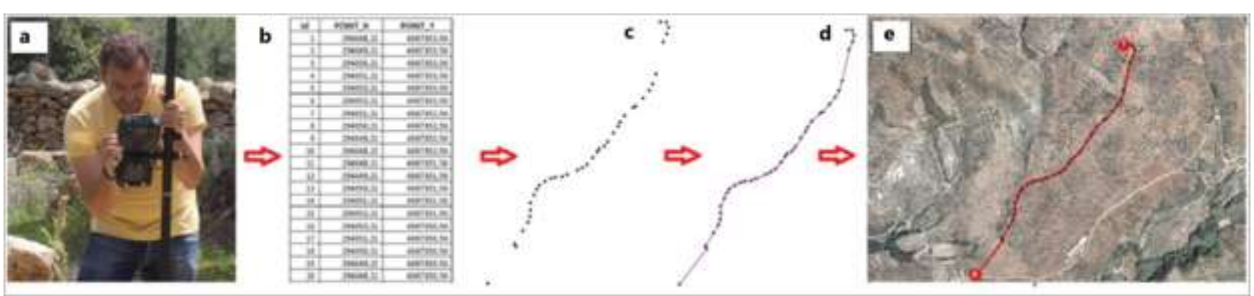

Figure 15: All the different work phases (a-b-c-d-e) of the Zero Point Cad approach.

The second approach is the so-called "Mapping Cad," which uses an opposite methodology. There are no blank sheets of paper or screens in any design software. However, there is a map from which the route can be designed without needing an on-site autopsy. The question is whether this approach is appropriate and to what extent it can be considered complete.

Let us look at an example of the case where we have a satellite image as a cartographic background, in the same example we experienced earlier in Neokastro. So, let us assume that in addition to route A-B, a second route, C-D-E needs to be plotted on the map we are planning. It is obvious that the route from node C to node D is easy to draw, but what happens in the case of nodes D-E, where above the already marked route, there are tall trees that hide the continuation of the route (Figure 16).

Figure 16: Tall trees (or high vegetation) obscure the continuation of the route.

Since route D-E is not visible, it could be a line that continues as in the previous nodes C-D (Figure 17) or changes its geometrical characteristics and continue as a curved line (Figure 18).

Figure 17: The D-E route is designed as a straight line under dense vegetation.

Figure 18: The D-E route designed as a curved line under dense vegetation case.

Discussion

Both methods have significant disadvantages. These are mainly concentrated in the following points and presented in Table 1.

Table 1: Summary table of the disadvantages between the two approaches.

The main problems of the Zero Point Cad approach:	The main problems of the Mapping Cad approach:
1. Incorrect use of measuring instrument tools (GPS, drone, geodetic station) *2. Poor judgment in the choice of the measuring instrument (GPS in urban environments with high buildings or in areas with intense geomorphology, in canyons, or areas covered by mountains)* *3. Poor transfer of data to the map (software crash or poor calibration of the instrument, in which case it is advisable always to make handwritten notes)* *4. Areas with limited access or areas that are not accessible at all (solution: drone).* *5. It takes longer to complete the entire project (takes time)* *6. Working in adverse conditions is usually required and inevitably involves more and more tedious work (requires effort)*	*1. Important information that we could see and draw during an on-site autopsy is not included.* *2. Loss of digitization of nodes (when we have satellite images as background, e.g., in cases of high vegetation)* *3. Poor performance of route geometry (fewer intersections, more straight lines).* *4. Incorrect representation of nodes and features of the route (at other positions).* *5. The person planning the route does not have an accurate sense of the details of the interconnected locations and the wider landscape.*

The best approach, suggested by the authors and used in practice in 90% of cases when designing a cultural route, is the third case of the approach. This one, concerning the mixture of the above techniques, is divided into two work phases and is called “Zero Map Cad Combination” (Malaperdas, 2023).

The first work phase that is carried out is the preparation of the map with the necessary notes and explanations to properly start the second phase, which is the mapping of the nodes and, thus, the route in general that supports the site visit (Figure 19).

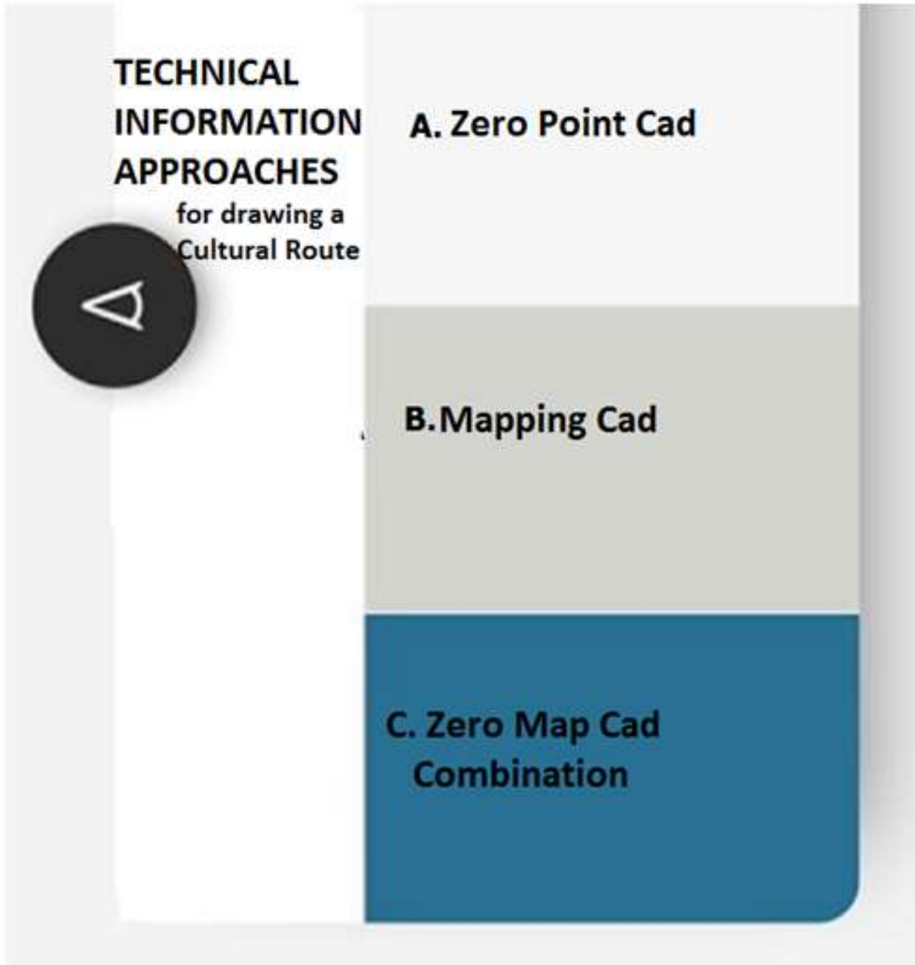

Figure 19: Technical Information Approaches to draw a Cultural Route

The entire acquisition, review, evaluation, and drawing of a Cultural Route is the subject discussed in this paper. This study is noteworthy because it is the first documented bibliographic reference on the subject, which not only encourages new authors to use the basic principles described above but, more importantly, guides them to its further development.

Conclusions

Cultural routes, apart from being mediators of the cultural heritage of each place, are identical to the concept of cultural tourism. They are associated with the economic development of a place, and their purpose is its prosperity (Stebbins, 1996; Csapo, 2012). Types of alternative tourism are often created to stimulate the local economy and its development, always respecting the environmental rules of the region (Picard, 1996; Petroman et al., 2013).

The correct, detailed mapping of a cultural route may be a one-way street in this direction. With the rapid development of technology, there are several possibilities that did not exist before. Computers combined with fast internet have delivered to our lives many free applications that have been developed so that anyone, without any particular knowledge, can enter a platform, set points of interest, and set up his own route, also adding photos and text for each point of interest. Users can follow the route and update it via mobile phones and tablets with new posts and knowledge. Also, information banks can provide attractive new data to spotlight the place of interest. Another important piece of information worth mentioning is that now, a cultural route is not a simple map that one follows the route and that is all, as it may have been in the past decades when there were so-called cultural or thematic routes with the difference that they were not clearly defined in the conceptual context we are discussing today.

Nowadays, a cultural route is based on the map, and to be competitive, it must have a website that will attract visitors. It will have the required photographic material, the necessary stories, myths, and legends for every point of interest (Koo et al., 2016). The corresponding information and everything that can exist in the digital experience that one will encounter in each route to transition from the digital experience to the tangible tourist experience and, therefore, the tourist development of every area, always with respect for the environment.

Altogether these cases of route drawing and wanting the simplest possible planning with a more professional and holistic look, the steps and methodology proposed in this paper can guide this direction. What changes each time are our capabilities and, therefore, the means we will use, also because of the theme of every route we will be called to follow. A cultural route, elements of which can be captured through the personal eye, not only of the one who will envision it but also of the one who will be called to design it, draw it, and eventually highlight it.

Acknowledgments: This project was implemented within the scope of the "Exceptional Laboratory Practices in Cultural Heritage: Upgrading Infrastructure and Extending Research Perspectives of the Laboratory of Archaeometry," a co-financed by Greece and the European Union project under the auspices of the program "Competitiveness, Entrepreneurship and Innovation" NSRF 2014–2020.

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