

ANALYZING, DIGITIZING AND TRANSFORMING AN ANALOG MAP INTO DIGITAL FORMAT IN ORDER TO MODERNIZE THE INFRASTRUCTURE

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Abstract. *The purpose of the work is to analyze, digitize and transform analog maps into digital format in order to modernize road infrastructure and land improvement networks. In this work, was pursued the analysis and digitization of analog maps at a scale of 1:25000 in digital format - L-34-78-D-b (Cărpiniș, Iecea Mică, Beregsău Mic) and L-34-79-C-a (Săcălaz, Beregsău Mare, Becicherecu Mic and Dudești Noi). The work presents the following stages in the realization of the project: the organization stage necessary for the transformation of the maps into digital format, the materials and methods used, the data processing in order to transform the analog maps into digital format necessary for the achievement of thematic maps that include the localities within the territorial administrative units Săcălaz, Cărpiniș, Becicherecu Mic, Iecea Mică, Beregsău Mic and Dudești Noi. After analyzing the maps, it was concluded that, in order to digitize and transform the maps from analog to digital format, the following specialized programs are needed: AutoCAD 2013, Raster Design 2013 and TransDatRO 4.06. In order to digitize and transform maps from analog to digital format, the following methods are required: georeferencing, vectorization and data interpretation. After establishing the methods, this whole transformation process was carried out in the AutoCAD program through several stages, resulting maps in digital format in order to interpret the data and create the thematic maps necessary for the updating, modernization and achievement on a modern basis of the infrastructure that connects the component localities of the 4 administrative territorial units.*

Keywords: *cartography, map, georeferencing, vectorization.*

INTRODUCTION

Digital cartography is the discipline that deals with the preparation, drafting and editing of maps and thematic plans with various applications in practice. It is a branch of general cartography that over time, along with the development of infographic technology, has undergone permanent improvement, being constantly in tune with current events.

The analogue map, generically called a "classic" map, represents a conventional image of the land (of the Earth), in which points (high-voltage poles, trees, wells, etc.), lines (roads, watercourses, level curves, etc.) and polygons (buildings, parcels, functional areas, etc.) indicate the position and spatial shape of geographical objects and graphic symbols and texts describe these objects. (BÂRLIBA C., Technical and cartographic drawing, 2006)

In this work, was pursued the analysis and digitization of analog maps at a scale of 1:25000 in digital format - L-34-78-D-b (Cărpiniș, Iecea Mică, Beregsău Mic); L-34-79-C-a (Săcălaz, Beregsău Mare, Becicherecu Mic and Dudești Noi).

MATERIAL AND METHODS

After analyzing the maps, it was concluded that, in order to digitize and transform the maps from analog format to digital format, the following specialized programs are necessary: AutoCAD 2013, Raster Design 2013 and TransDatRO 4.06. With the help of the AutoCAD Raster Design application, it is possible to transform, edit and prepare the information in raster format, we can analyze various images and transmit the drawings made to other programs such as: AutoCAD Civil 3D and AutoCAD Map 3D. We can edit, correct and create raster vector

hybrid drawings, or you can vectorize scanned drawings eliminating the need to redraw them. (BĂRLIBA C., 2006, Engineering Drawing and Cartography)



Figure 1. AutoCAD Raster Design 2013 program

To be able to make digital maps, the official projection system of the country must be used. The official system of Romania is the Stereographic Projection 1970. To transform cartesian coordinates into rectangular coordinates in the Stereo 1970 system, it was necessary to use the TransDatRO 4.06 application.

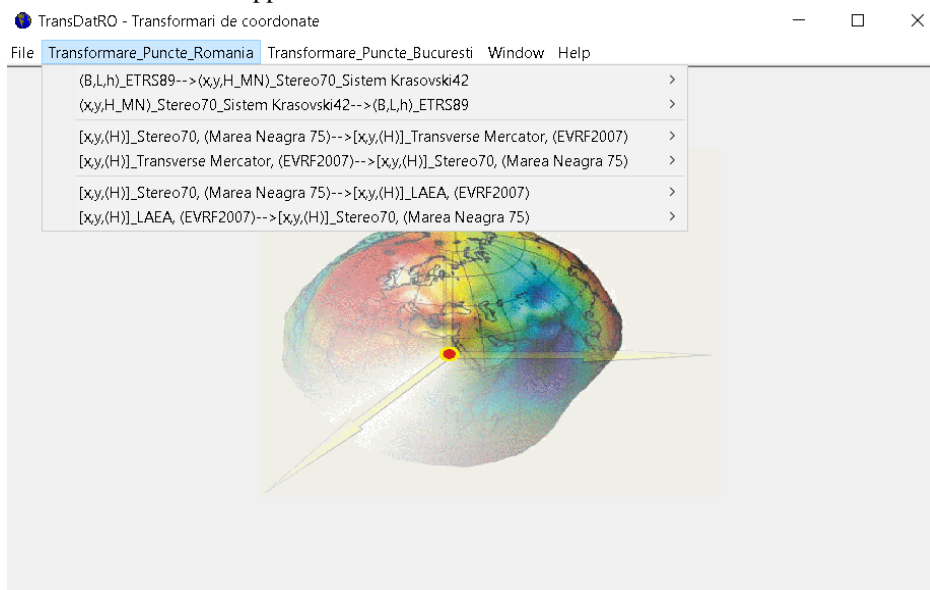


Figure 2. TransDatRO program

In order to digitize and transform maps from analog to digital format, the following methods are necessary: georeferencing and vectorization. Georeferencing is the process by which an image (map, satellite image, etc.) is assigned certain coordinates. Within the study, georeferencing will be done in AutoCAD 2013, Raster Design 2013.

Georeferencing (attributing coordinates) is the process of associating digital maps with real geographic coordinates (is called georeferencing). There are also applications in which it is

not necessary to switch to real coordinates, a local (cartesian) coordinate system being sufficient. (Bârliba L, 2015).

The next method, more precisely vectorization is the process by which digital data is built with the help of images. The vectorization of plans and maps from the classic support in digital format can be achieved by digitizing the characteristic elements, thus bringing the plans into a vector format with multiple exploitation possibilities. The graphics are made under the licensed program AutoCAD and we can save the files with the extension: CDR, EPS, TIFF, JPG, GIF, PNG, or other formats depending on the request. (Popescu C. et all., 2016)

This study was performed using layer vectorization for the virtual map.

RESULTS AND DISCUSSIONS

To make the L-34-78-D-b and L-34-79-C-a maps AutoCAD, AutoDesk Raster Design and the TransDatRO program were used for coordinate transformation.

Since the way of working is the same for all maps, only one of the two maps is presented below. The work is done in stages, these being rendered through Print Screens.

The first stage is the coordinate transformation stage. The transformation of the coordinates using the TransDatRO program was carried out as follows.

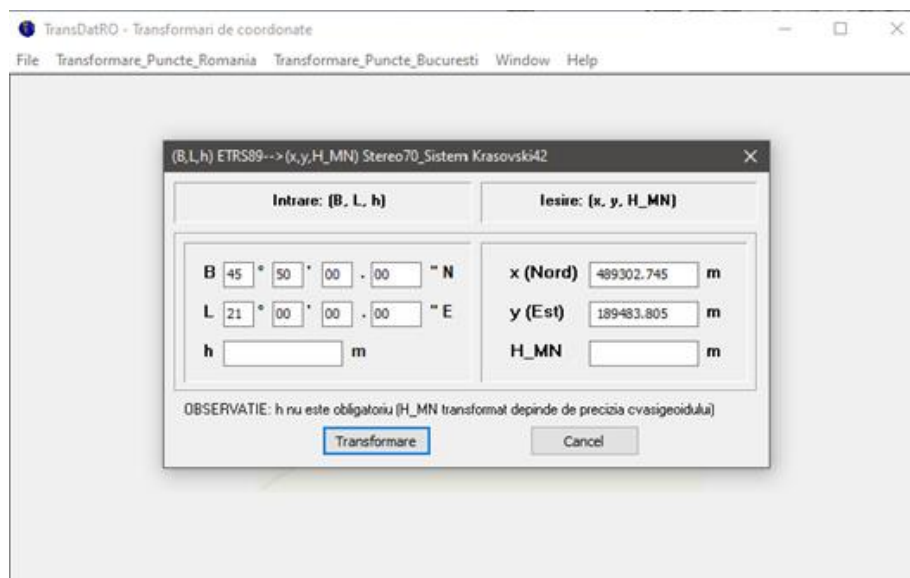


Figure 3. Calculating coordinates using the TransDatRO application

The transformation of the coordinates of the corners of the L-34-79-C-a map is represented in the following table.

Table 1

Nomenclatura	Coordonate geografice		Coordonate rectangulare Stereo 1970	
	Latitudine	Longitudine	X	Y
L-34-79-C-a				
NV	45°50'00''	21°00'00''	489302.745	189483.805
SV	45°45'00''	21°00'00''	480048.900	189019.555
NE	45°50'00''	21°07'30''	488823.302	199187.022
SE	45°45'00''	21°07'30''	479569.091	198737.286

The second stage represents the setting of the work page.

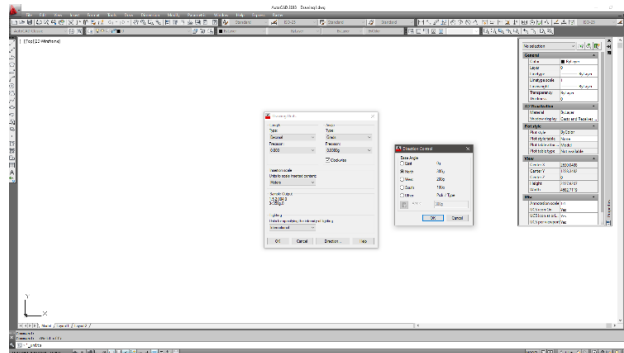


Figure 4. Work page setup

The working page was set up like this: Format - Units (Length Type: Decimal, Precision: 0.000; Angle Type: Grads, Precision: 0.0000g; Insertion scale: Meters, Direction Control: North).

The third stage consists in entering the Stereo 1970 coordinates which were obtained by transforming the WGS84 geographical coordinates into Stereo 1970 with the help of the TransDatRO application.

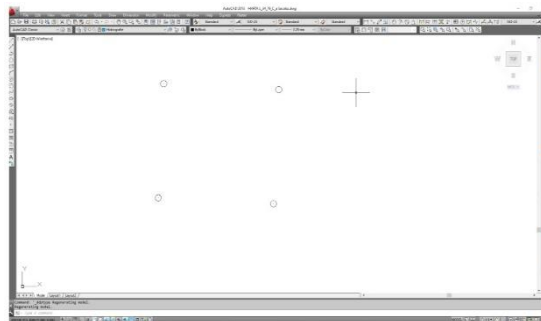


Figure 5. Entering the coordinates

In the fourth stage, the map frame was created by joining the four points with the help of Polyline.

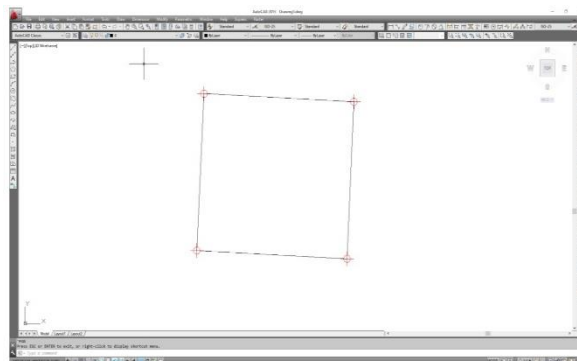


Figure 6. Map frame

The program Raster Design - Insert - was used to bring the map into AutoCAD. After bringing the map into AutoCAD, align the map with the border formed by the four points using the ALIGN and SCALE command.

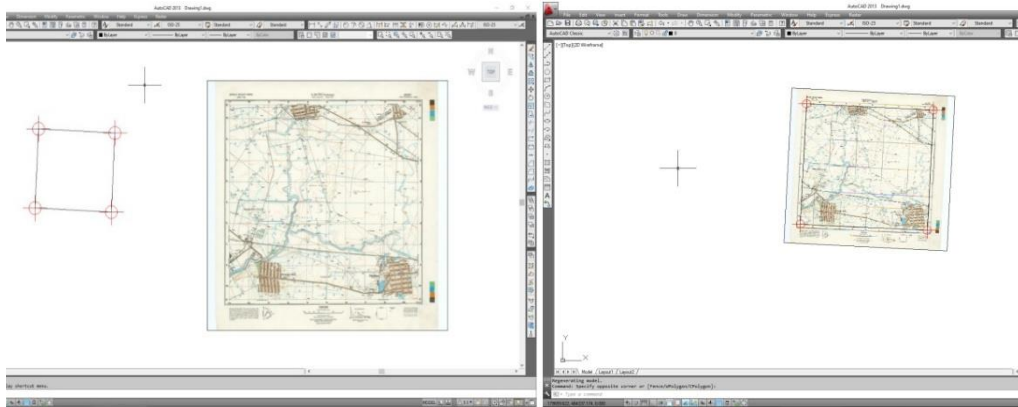


Figure 7. The introduction of the topographic map in the formed border and the framing of the map

The fifth stage consists of creating layers using the Layer Properties Manager command.

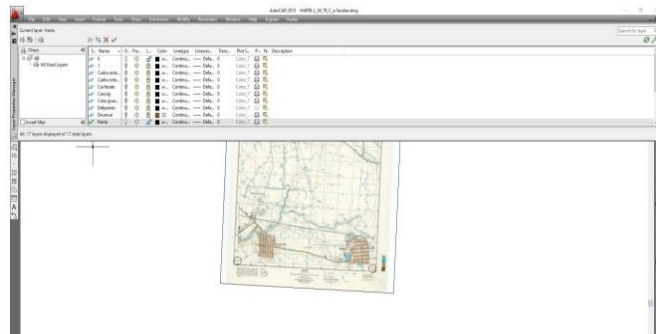


Figure 8. Creating layers

The sixth stage represents the way in which the map is drawn in AutoCAD. The first step is to draw the outer grid and the inner grid of the map.

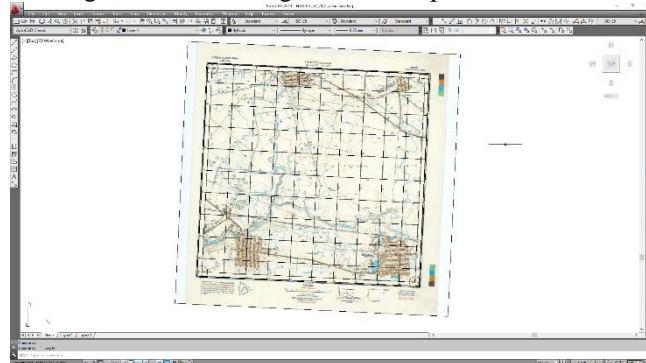


Figure 9. The outer grid and inner grid of the map

Next, level curves, elevations, roads, vegetation, infrastructure, hydrography will be drawn using the Spline command. All these being the elements that constitute the map. The elevations and level curves are represented in the image below.

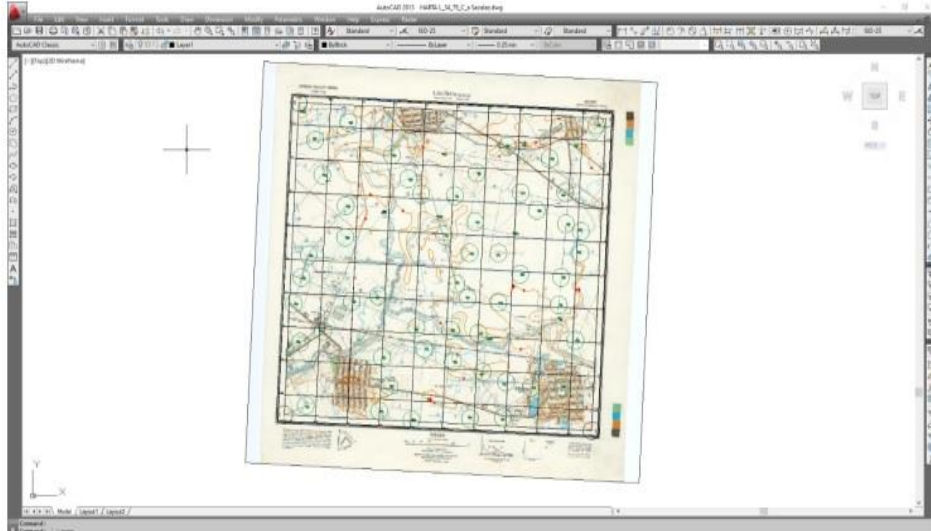


Figure 10. Elevations and level curves

In the seventh stage, the way in which the map is drawn in AutoCAD is represented. The actual digitization of the map was done in layers, a layer being created for each element. The drawn and layered map will look exactly like the initial map at the end.

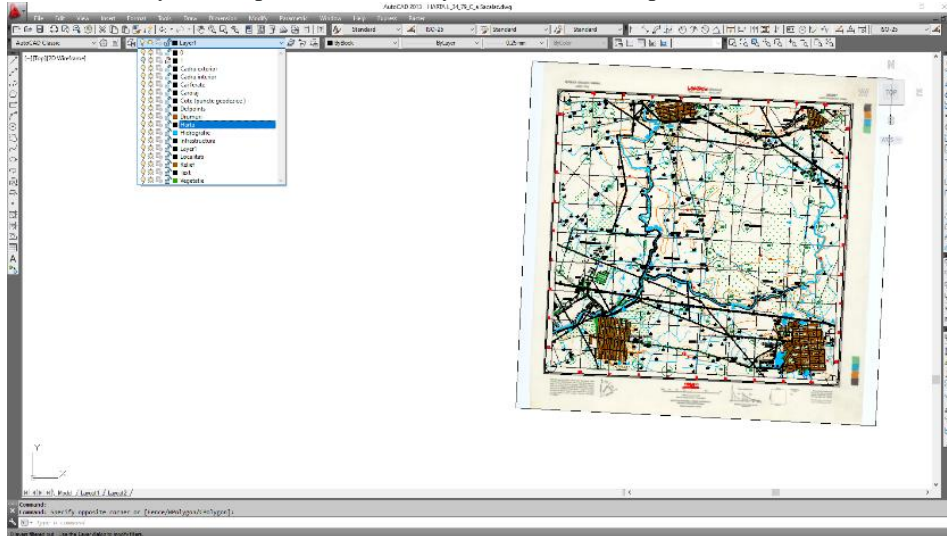


Figure 11. The final topographical map

The way of working is the same for the other map. The following images are the final result after digitizing and transforming the analog maps into digital format using georeferencing and vectorization (Figures 12-15).

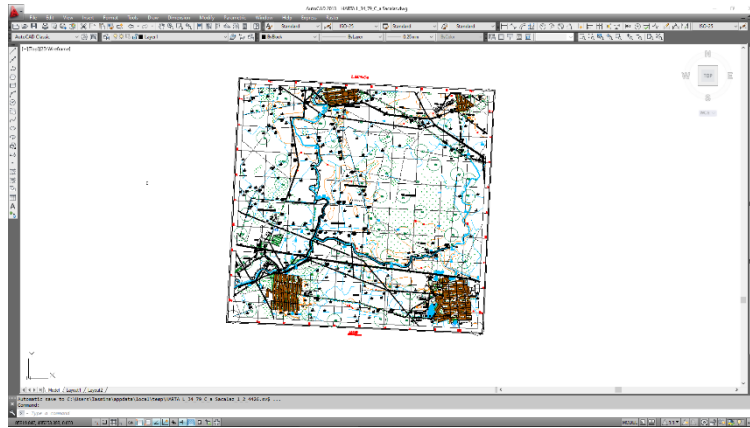


Figure 12. Topographic map L-34-79-C-a

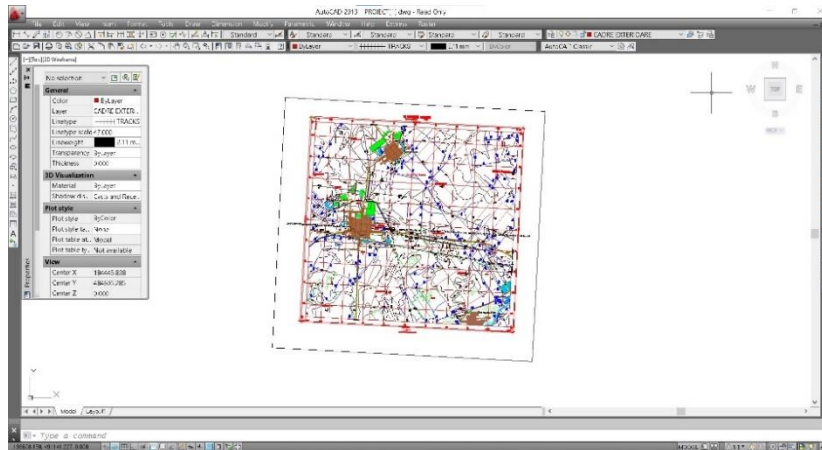


Figure 13. Topographic map L-34-78-D-b

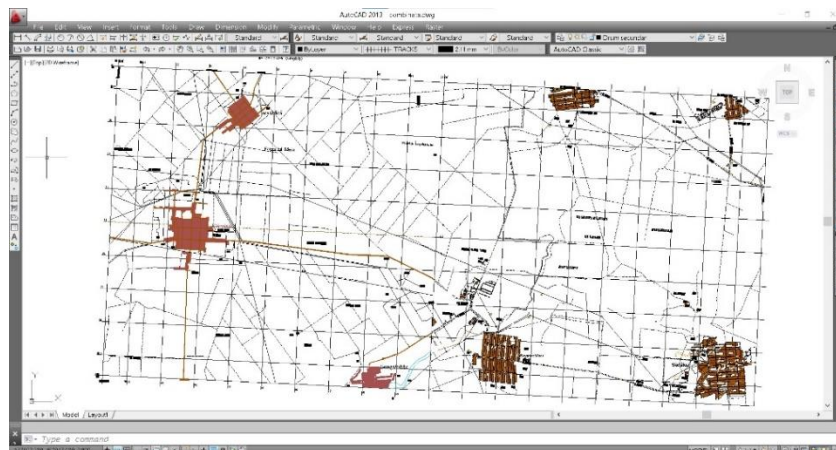


Figure 14. Map of the infrastructure of territorial administrative units

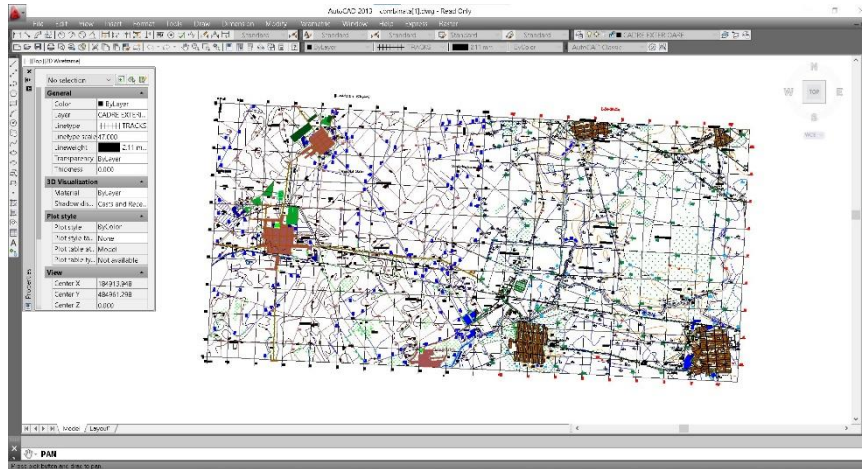


Figure 15. Topographical map of territorial administrative units

CONCLUSIONS

The programs used for this work are: AutoCAD, Raster Design and TransDatRO. AutoCAD is a CAD program used in the design of construction plans in two dimensions (2D), less in three dimensions (3D), developed and marketed by the American company Autodesk. System-specific files are dwg and dxf (Drawing eXchange Format). With the help of the AutoCAD Raster Design application we can transform, edit and prepare the information in raster format, we can analyze various images and send the drawings made to other solutions such as AutoCAD Civil 3D and AutoCAD Map 3D. Improving decision-making processes and the quality of presentations for any project, using the benefits offered by information in raster format with the help of the AutoCAD Raster Design application. We can edit, correct and create raster vector hybrid drawings, or you can vectorize scanned drawings eliminating the need to redraw them. TransDatRO performs the standard coordinate transformation between the reference system and the Stereographic 1970 projection.

In conclusion, this study of the analysis, digitization and transformation of analog maps into digital format is due to the programs mentioned above and aimed at maps in digital format in order to interpret the data and create the thematic maps necessary for updating, modernizing and creating them on a modern basis of the infrastructure that connects the component localities of the 4 administrative-territorial units.

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