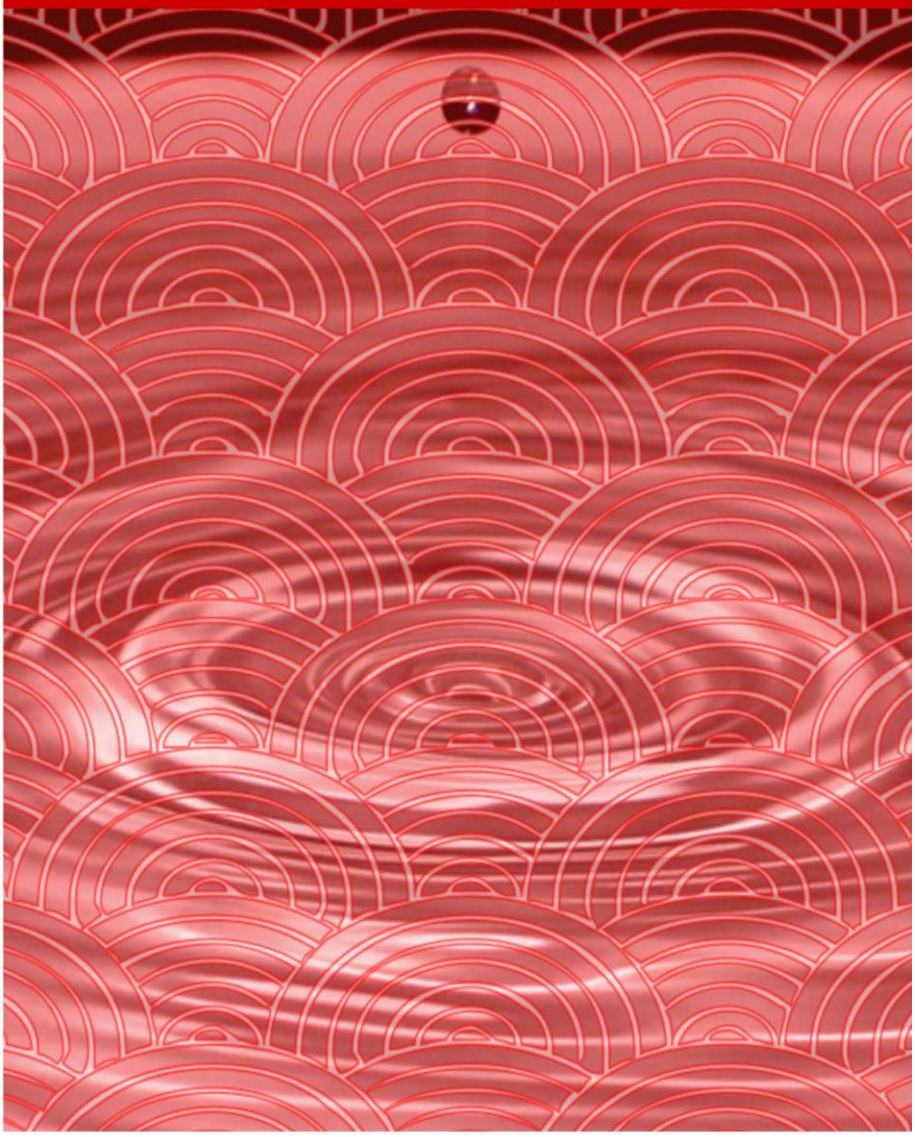
Volume 3, Issue 1, April 2017

GeoPatterns



University of Bucharest

Center for Risk Studies, Spatial Modelling, Terrestrial and Coastal System Dynamics

Editura Universităţii din Bucureşti

EDITORIAL STAFF

University of Bucharest

Center for Risk Studies, Spatial Modelling, Terrestrial and Coastal System Dynamics

GeoPatterns

Volume 3, Issue 1, April 2017

editura universității din bucurești®
2017

© editura universităţii din bucureşti®
Şos. Panduri, 90-92, Bucureşti – 050663, România
Telefon/Fax: (0040) 021.410.23.84
E-mail: editura.unibuc@gmail.com; editura@g.mail.ro
Web: www.editura-unibuc.ro/magazin/
Centru de vânzare: Bd. Regina Elisabeta, nr. 4-12, Bucureşti
Tel. (004) 021.305 37 03

Desktop Publishing: *Meri Pogonariu*

ISSN 2501-7837
ISSN-L 2501-7837

Summary

GeoPatterns, Vol. III, Issue 1, April 2017, pp. 6-12

A summary of CRMD new research on landslides using multi-temporal InSAR techniques based on Sentinel-1 data

Iuliana Armaș
Faculty of Geography, University of Bucharest
iulia_armas@geo.unibuc.com

Abstract. The new landslide research direction at CRMD aims to improve and develop new applications of ground-based validation techniques of satellite radar interferometry displacement products, based on Sentinel-1 data. The test area is the high slope instability ridge of the Carpathian and Subcarpathian Prahova Valley due to natural and anthropogenic factors. We use sets of single polarized synthetic aperture radar (SAR) satellite data acquired by historical (*i.e.*, ERS-1/-2 and ENVISAT) and recent (Sentinel-1) satellites, and multi-temporal radar interferometry (InSAR) methodologies to provide maps of line-of-sight displacements. We apply some of the most advanced differential interferometric Synthetic Aperture Radar techniques at the moment, Persistent Scatterer Interferometry (PSI) and Small BASeline Subset (SBAS); both of them are applied for depicting areal or point deformations. Deformation maps and time series are integrated with Geographical Information System (GIS) multilayer analysis results derived from classical methodologies (*i.e.*, geological and geomorphological methods), and field research. InSAR analyzes are calibrated and validated using GNSS techniques and GIS slope modelling based on Lidar and radar obtained DEMs. The short-term results are highly reliable interferometric measurements. On a long term, the results imply the understanding of slope dynamic in the context of major human environmental change. The latter achievement could offer the support to successful risk mitigation methodologies in mountain areas.

Keywords: *Landslides, InSAR, Permanent Scatterers, SBAS, GNSS*

1. INTRODUCTION

Landslides are among the most widespread geomorphological processes in the hilly regions of Romania built of Neogene molasse deposits, as well as in the mountainous regions developed on Cretaceous and Paleogene flysch (Balteanu *et al.* 2012), were slope instabilities raise frequent problems to authorities and stakeholders. Slope instability is estimated as a concordance/non-concordance association between specific local evolution patterns, reflected in a specific slope geometry. The principle behind this thinking is the fact that the dynamic of any geomorphological system is imprinted in its shape. If the shape is concordant with the sustained dynamic pattern then the geomorphological system is stable and has a reduced vulnerability. If the non-concordance between shape and internal dynamics increases, the system moves towards changing its shape. The resistance to change leads to build-up pressure growing the potential of sharp discharges of energy, manifested in this case as slope dynamics.

Landscapes with high relief energy represent areas of high potential instability, as slope-type surfaces are the dominant geomorphological features. More than 60% of Romania territory is represented by orogeny, and is highly sensitive to climate changes.

The danger of potential unstable slopes to human habitats, especially in hilly and mountain areas – as slopes are dominant – is also of primary importance

in practice and research after 1990, due to an explosive increase in value of the damage caused especially by landslide disasters (UN/ISDR, 2004; CRED, 2015). Observing potentially unstable slopes is also of primary importance in accordance with sustainable development requests, as pointed out by the European Commission in several documents (*e.g.* EC 2009-2014), in the context of predicted environmental changes (*e.g. IPCC 2012, EEA 2005, EEA 2007, EEA 2012* – http://www.eea.europa.eu*)*.

Slope instability research has long term theoretical and practical results, offering the support to successful risk mitigation actions in mountain areas at European and international level (*e.g.*, Lee *et al.*, 2002, Sarkar *et al.*, 2004, Thaiyuenwong and Maireang, 2010; Muntohar and Liao, 2010). The Earth observation from space component is essential in understanding slope dynamics. Successful applications have applied ground-based and remote sensing techniques and products; the on-going trend being the multi-technique landslide observations for multi-scale analysis (*e.g.*, Noland *et al.*, 2003, Metternicht *et al.*, 2005). More recently, multi-temporal InSAR techniques represent an important tool for measuring landslide displacement that offers a repeated insight over the area of interest at various scales (Necsoiu *et al.*, 2014).

In Romania, landslide investigations have a long tradition, but more in a descriptive way and focused on the geomorphological mapping. Susceptibility and hazard maps, based on expert judgment and heuristic methods associated with the use of GIS techniques, or even statistical methods, have been elaborated after the year 2000 (*e.g.*, Armas 2011, Armas *et al.*, 2014, Bălteanu and Micu 2009, Micu *et al.*, 2010, Micu *et al.*, 2014) but the analysis of slope instability in Romania hasn't been based on satellite interferometric products so far.

The launch of Sentinel-1 brings new opportunities in unstable slopes and landslides monitoring applications. Sentinel-1 is a two-satellite constellation for Land and Ocean monitoring, consisting of Sentinel-1A and Sentinel-1B satellites. Launched by ESA on 3rd of April 2014 and 25th of April 2016 respectively, the two satellites provide C-Band SAR data continuity at a spatial resolution of 20 m x 5 m, after the retirement of ERS and Envisat missions. The C-band sensor offers high temporal resolution data, made freely available by ESA. The constellation of two satellites orbit the earth 180° apart, providing data every 6 days.

Due to the novelty of the data, the studies that have been done so far are exploratory, assessing the potential of using Sentinel data in different applications (Rucci *et al.*, 2012; Jung *et al.*, 2013; Funning *et al.*, 2015). Barra *et al.*, (2016) conducted a study for mapping and characterizing landslide processes in Molise, Italy, applying Differential Synthetic Aperture Radar Interferometry (DInSAR) to Sentinel-1 data for obtaining deformation maps and time series, integrated with Geographical Information System (GIS) analysis. The initial results were promising, the satellite data being able to distinguish new areas affected by landslides, updating the existent landslide map inventories. In the future, Sentinel-1 data is expected to become even more useful, due to the probability of improving the temporal resolution from 12 to 6 days, which is considerably higher in comparison to other sensors.

2. SCIENTIFIC OBJECTIVES AND STUDY AREA

The overall objective of the new research at CRMD **is to offer integrated techniques of validation and calibration performances of InSAR ground displacement products based on Sentinel-1 data, developed and tested in a variety of environments.** To achieve this aim, the workflow will ***integrate (i) Geographical Information System (GIS) multilayer analysis with (ii) InSAR-based terrain displacement maps derived from Sentinel-1 data and (iii) ground monitoring activities that can validate the InSAR data***. To do so, the ongoing research unfolds according to the following secondary objectives:

1. Identify several test areas based on geological and geomorphological mapping, diachronic cartography and on change analysis products.
2. Develop improved InSAR-based displacement products using Sentinel-1 single-polarized data focusing on selected areas.
3. Validate radar displacement products based on Global Navigation Satellite System or GNSS

and levelling geodetic measurements, as well as conventional geological and geomorphological research.

The study area is focused on one of the most complex units in terms of lithological and structural conditions, the Carpathian and Subcarpathian Prahova Valley. Prahova Valley is a landslide prone area that marks the boundary between the Eastern and the Southern Carpathians, located in a heavily faulted area and being affected by tectonic activity (Fig. 1).

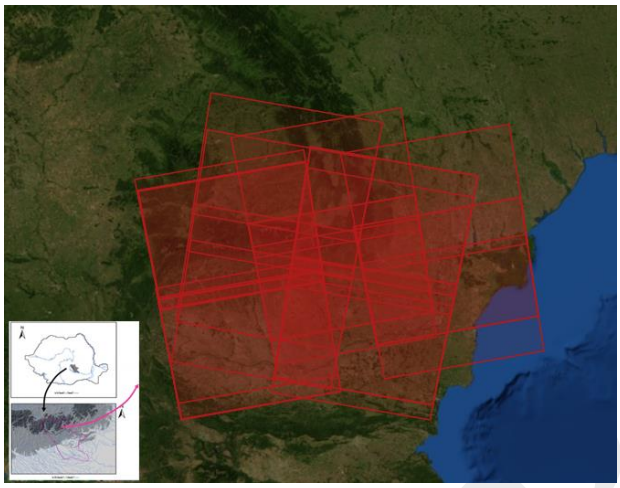


Figure 1. *Study area overlay of the Prahova Valley with respect to the footprint of achived Sentinel-1 data*

Prahova Valley is part of the external Flysch facies of Lower Cretaceous – Pliocene age. On the valley slopes, there are numerous diluvia developed starting with the first terrace of the Prahova River continuing through to upper terraces. The diluvia are mainly composed of sandstone fragments and limestone with granulation varying from fine to coarse sizes, cemented by a clay-silt matrix, which determines an accentuated instability of the slopes especially in areas without woody vegetation. The diluvium has a thickness of about 2 m. The base stratum is represented by the external Flysch facies with a high degree of fracturing and alteration to a depth of about 5 m, arranged in synclines and anticlines, especially in the tributary valleys of the Prahova River. In areas with isolated reverse faults there are deeper landslides and rock falls.

Overall, the Curvature Carpathians and Subcarpathians are susceptible to landslides as a predominant slope process, being also part of the Vrancea Seismic Region with the most active subcrustal earthquake activity in Europe (*e.g.*, Balteanu *et al.*, 2012, Radulian *et al.*, 2006). Landslides prevail in conditions of a heavily fractured flisch and broad molasses sheets with alternating layers of clay and marl, in the hilly area. Prahova Valley is also the most inhabited area of the Romanian Carpathians and Subcarpathians and an important Trans-Carpathian thoroughfare between the Balkan countries and the Orient. During the last century railway, roads, bridges and channel regulation and bank protection works were built along the Prahova Valley, together with oil and in-channel gravel exploitation. In these conditions, the urbanization development, which implies the deforestation of huge areas, will generate destabilization of slopes with cascade slope processes, especially in the Posada mountain pass and on the mountain slopes.

The field studies carried out by Professor Armas along the Subcarpathian Prahova Valley over a period of seven years, as a part of a collaborative effort on landslide vulnerability and disaster mitigation financed by the Romanian government, allowed the researchers to understand fluvial morphology and valley evolution. Channel adjustment was analyzed by comparing the old topographical maps (1864-2006), the satellite images, the orthophotomaps and the land topo-bathymetric survey performed in the summer of 2006 and 2012. The Subcarpathian area of the Prahova Valley suffered a transformation from an accumulation area to a sediment transfer zone in the present. Human negative impact amplified the natural, long-term tendency of this river for incision, narrowing and transition from a braided into a sinuous, single-thread platform pattern (Armas *et al.*, 2013). These changes have immediate and lasting effects on slope dynamics too, as the evolution of slopes is interconnected with riverbed evolution.

3. METHODOLOGY

The C-band SAR imagery is considered the ideal candidate to use in landslide monitoring along the Prahova Valley mainly because the highly-vegetated

environment and steep topography. Therefore, multitemporal InSAR analysis could accurately characterize the stability of this area, being specifically designed to identify and quantify movement of potential area-based natural features (*e.g.*, rock outcrops and boulders) and localized man-made structures (*e.g.*, railroad-related objects) in different types of environments.

The InSAR techniques used in this research are as follow [for in-depth analyses, see also the invited book chapter Necsoiu and Hooper (2009)]:

• Persistent Scatterers (PS) is an InSAR technique used to detect very small displacements (mm scale) and to infer the deformation velocity – and its variation over the time – in particular for very stable (man-made) reflectors that might have independent displacements in respect to the surrounding areas (Ferretti *et al.*, 2000; Ferretti *et al.*, 2001; Hooper *et al.*, 2007).

• Small Baseline Subset (SBAS) is a complementary InSAR technique that exploits differential synthetic aperture radar interferometry (DInSAR) techniques to analyze stacks of SAR acquisitions to extract small deformations over large areas, when no point targets are identified but large, correlated displacements occur over natural targets (Berardino *et al.*, 2002; Lanari *et al.*, 2004). Since the conditions of strong nonlinearities in ground displacements affect InSAR results (Necsoiu *et al.*, 2014), destabilization of large areas could make the issue of selecting optimal areas for monitoring even more problematic. Multitemporal InSAR analysis of historical data will be performed using SBAS data, and on recent Sentinel-1 data once more than 6 SAR images will be acquired. Once more than 20 images will be available, PS analysis will be employed to derive land stability maps.

If there will be no sufficient number of stable scatterers that remain coherent during the observation period (Hanssen, 2001) and low coherence between SAR images acquired over landslides fully covered by vegetation, artificial reflectors could be necessary. The artificial rleflectors will be positionated to reduce the atmospheric effects as pointed out by (Crossetto *et al.*, 2013).

The research presents several challenges to conventional InSAR, including the following:

(i) The expected low displacement rates (*e.g.*, mm/year) and a small-time span between the first and last available radar images, requiring the use of high sensitivity InSAR methods. The vegetation cover could also represent an impediment in conducting the study.

(ii) Although radar technology is considered weather independent, there are meteorological conditions that can affect the quality of the SAR images. One phenomena that has a negative impact on the quality of the images is heavy rainfall during the passing of the satellite. Anyway, the high temporal resolution of the Sentinel-1 satellite greatly improves the chances of acquiring high quality images. In addition, there might be a limited number of months (*e.g.*, 9 months) with no snow cover. Because deep snow is an impediment in using radar interferometry technologies, heavy snowfall and prolonged periods of snow cover may reduce the time interval suitable for observations.

In our research detection and monitoring through Sentinel-1 based displacement maps will be corroborated with conventional geological and geomorphological methods. Evolution trends identified through hydraulic models, diachronic cartography and field interdisciplinary research during 2003-2006, will be correlated with complex measurements resumed in 2012, and terrestrial monitoring. The statistical methods for active landslide susceptibility mapping will be applied in combination with GIS for valley-scale analyses, whilst deterministic – or physically-based – methods will be used for local-scale analyses, either with GIS (mainly the infinite slope stability model) or without GIS (usually applied on vertical sections with circular or elliptic sliding surfaces).

For the statistical approach, we will use the weight-of-evidence method, based on the log–linear form of the Bayesian probability model, and detailed thematic layers: landslides inventory maps, slope features such as gradient, aspect, soil, etc., faults coverage, lithology, hydrological network, landuse and other parameters derived from different thematic maps and field surveys. The "predictive power" of the resulting weight maps will be tested by analyzing their success rate and prediction rate.

For the deterministic-based approach on shallow landslides susceptibility mapping, the one-dimension

infinite slope stability model will be joined with a raster based GIS (ILWIS). Input parameters will consist in slope parameters (obtained from DEM processing), hydrological components (based on groundwater table mapping), and the geotechnical background (soil cohesion, unit weight and internal friction angle for the geological formations). The needed values will be obtained from scientific literature in the field, or collected from mines (mining and drilling) and own field studies. The model can be used in GIS software, because the calculation is done on a pixel basis, each raster cell being considered individually

An important task of InSAR instability maps will be to ***monitor landslides*** at a high accuracy level. Best outcomes will be obtained with multi-temporal SAR to measure displacement rates or expected landslides velocities anticipated from historical knowledge, using intensity – and coherence-tracking and cross-correlation techniques

For evaluating the results obtained by InSAR techniques, our partners from the Technical University of Civil Engineering of Bucharest will design a tracking network, following the principles of its determination with GNSS technology but also the principles used to monitor movements. Points belonging to this network will be considered "safe", stable with no changes in position over time. This will provide a monitoring reference network that will be connected to the reference system WGS84/ETRS89. Other points evenly distributed in the area of interest will be used as tracking points, points that will form the basis of monitoring. The network with stable ground points materialization and tracking points will be chosen on surfaces with geomorphological significance (*e.g.*, bridge terrace, slopes and landslide glacis) to monitor landslide processes at different spatial and temporal scales of manifestation. To obtain reliable and accurate results, the static GNSS method occupation for positioning determination will be used.

Monitoring landslides will conduct to an analysis on two references. An analysis in 2D space monitoring level (planimetric reference) and altimetric monitoring (altimetric reference). The altimetric monitoring will be made also using the classical method of geodetic levelling that provides superior accuracy to any other method (Brigante *et al.*, 2012). Positioning using GNSS technology gives 3D geometrical solutions while precise levelling method only on altitude. However, the precise levelling method for vertical monitoring can be used as an alternative method for determining the deformation in the space with one dimension.

The collaboration between the Technical University of Civil Engineering of Bucharest and the University of Bucharest will emphasize validating internal and ecological consistency of InSAR displacement products and will lead to a scientific progress via the quantification (through separation of noise from relevant information) of slope dynamics in a tectonic active area.

All these is sought to increase the Romanian research and development competitiveness by creating a niche in slope instability studies, and combining spatial technologies with ground monitoring.

4. EXPECTED RESULTS

The outcomes of the study are (a) high resolution topical digital maps; (b) simulation maps, and (c) a detailed data base of changes in vertical topography, *i.e.* all point coordinates (latitude, longitude), and associated velocity (mm/yr), coherence, h_precision (m), v_precision (mm), height correction (m), and total displacement (mm), correlated and validated with ground displacement products and results from geomorphological and geological maps. We will deliver also quantitative statistical approaches that compare the spatial distribution of landslides with most relevant and mutually independent predictive variables, using the log–linear form of the Bayesian probability model. The final susceptibility logit map will compare to the safety factors resulted from applying the one-dimensional deterministic slope stability model (infinite slope model) in different dry and saturated scenarios. Specifically, time-series changes of land elevation and slope aspect variations determined via radar interferometry will help identify potential instability areas as a response to natural and human disturbances.

These outcomes will help to better address slope instabilities that produce landslides disasters, and better understand geomorphic processes through validated measurements underlying scientific models.

Spatial embedding of validated InSAR ground displacement products **will also permit GIS integration and correlation of results with all environmental features of a specific place, creating an integrated model with a focus on simplicity, usability and efficiency. This model could help to the awareness of problems arising from slope instabilities and could be used by local stakeholders and authorities for an action concept and risk mitigation plan within communities at risk**. Bridging the gap between scientists and practitioners is the great challenge in the need to develop effective and efficient strategies for landslide risk mitigation and we believe that our research could be a successful way to integrate science and practice.

5. CONCLUSION

The research is relevant through the solutions involving monitoring of instable slope systems, which will improve the current methods of terrestrial detection and the complex validation of satellite-based InSAR displacement products. We expect that our research results will have also a socio-economic impact in helping human settlements reducing vulnerability to landslides.

REFERENCES

Armaş I. (2011), Weights of evidence method for landslide susceptibility mapping. Prahova Subcarpathians, Romania, *Natural Hazards*, 60, 3, 937-950.

Armaş I., Gogoase Nistoran D., Osaci-Costache G., Brasoveanu L. (2013), MORPHO-DYNAMIC EVOLUTION PATTERNS OF SUBCARPATHIAN PRAHOVA RIVER (ROMANIA)**,** Catena, 100:83-99.

Armaş I., Vartolomei Fl., Stroia Fl. (2014), Landslide susceptibility deterministic approach using geographical information systems: application to Breaza city, Romania, *Natural Hazards*, 70(2), 995-1017

Bălteanu D., Jurchescu M., Surdeanu V., Ionita I., Goran C., Urdea P., Rădoane M., Rădoane N., Sima M. (2012), Recent landform evolution in the Romanian Carpathians and Pericarpathian regions, in Lóczy D., Stankoviansky M., Kotarba A. (eds.) Recent Landform Evolution. The Carpatho-Balkan-Dinaric Region, Springer, 249-286.

Barra A, Monserrat O, Mazzanti P, Esposito C, Crosetto M, Scarascia Mugnozza G. (2016), First insights on the potential of Sentinel-1 for landslides detection. Geomatics, Natural Hazards and Risk. Apr 1:1-0.

Berardino, P., Fornaro, G., Lanari, R., and Sansosti, E. (2002), A new algorithm for surface deformation monitoring based on small baseline differential SAR interferograms. IEEE Transactions on Geoscience and Remote Sensing, 40(11):2375–2383.

Brigante R, Radicioni F, Stoppini A, Fornaro F, Bovenga F, & Nitti OD, (2012). SAR, GNSS and leveling comparision on multi-annual series for the study of landslide surface deformation http://lnx.mimos.it/mimos_decennale/Proceedings/SicurezzaTerritorio_08_Stoppini.pdf

CRED (2015). Retrieved from International Disaster Database: http://www.cred.be/emdat.

Crosetto M, Gili, JA, Monserrat O., Cuevas-Gonźalez J. Serrat D. (2013), Interferometric SAR monitoring of the Vallcebre landslide (Spain), using corner reflectors, Nat. Hazards Earth Syst. Sci., 13, 923-933, http://nat-hazards-earth-syst-sci.net/13/923/2013/nhess-13-923-2013.pdf

Ferretti, A., Prati, C., & Rocca, F. (2000). Nonlinear subsidence rate estimation using permanent scatterers in differential SAR interferometry. IEEE Transactions on Geoscience and Remote Sensing, 38(5):2202-2212.

Ferretti, A., Prati, C., & Rocca, F. (2001). Permanent scatterers in SAR interferometry. IEEE Transactions on geoscience and remote sensing, 39(1):8-20.

Funning GJ, Floyd M, Walters RJ, Elliott JR, Wright TJ, Marinkovuc P, Larsen Y. (2015). Complexity in the coseismic fault geometry and in the postseismic slip distribution of the South Napa earthquake, from Sentinel-1A InSAR and near-field GPS data. Seismol. Soc. of Am. Meet., Pasadena, Calif. 2015 Apr.

Hanssen, R. (2001), Radar interferometry, Kluwer Academic Publishers, Dordrecht (The Netherlands).

Hilley, G. E., Burgmann, R., Ferretti, A., Novali, F., and Rocca, F. (2004), Dynamics of slow-moving landslides from Permanent Scatterer analysis, Science, 304 (5679), 1952–1955.

Hooper, A., Segall, P., & Zebker, H. (2007). Persistent scatterer interferometric synthetic aperture radar for crustal deformation analysis, with application to Volcán Alcedo, Galápagos. Journal of Geophysical Research: Solid Earth, 112(B7).

Jung HS, Lu Z, Zhang L. (2013). Feasibility of along-track displacement measurement from Sentinel-1 interferometric wide-swath mode. Geoscience and Remote Sensing, IEEE Transactions on. Jan; 51(1):573-8.

Lanari, R., Mora, O., Manunta, M., Mallorquí, J.J., Berardino, P., and Sansosti, E. (2004). A small-baseline approach for investigating deformations on

full-resolution differential SAR interferograms. *IEEE* TGRS 42 (7), 1377-1386.

Lee S., Choi J., Min K. (2002). Landslide susceptibility analysis and verification using the Bayesian probability model, Environmental Geol., 43, 1-2.

Metternicht, G., Hurni, L., Gogu, R. (2005). Remote sensing of landslides: An analysis of the potential contribution to geo-spatial systems for hazard assessment in mountainous environments. Remote sensing of Environment, 98(2): 284-303.

Micu M., Chendeș V., Sima M., Bălteanu, D., Micu, D., Dragotă, C. (2010), A multi-hazard asssessment in the Bend Carpathians of Romania, în vol. (Editori: Glade, T., Casagli, N., Malet, J.P) Mountain Risks: bringing science to the society, CERG Editions, Strasbourg.

Micu, M., Bălteanu, D. (2009) Landslide hazard assessment in the Curvature Carpathians and Subcarpathians, Romania, Zeitschrift fur Geomorphologie, Suppl.3, 53, Stuttgart, Germany;

Micu, M., Jurchescu, M., Micu, D., Zarea, R., Zumpano, V., Bălteanu, D. (2014). A morphogenetic insight into a multi-hazard analysis: Bâsca Mare landslide dam, Landslides, DOI 10.1007/s10346-014-0519-4

Muntohar, A. S. and Liao H-J. (2010). Rainfall infiltration: infinite slope model for landslides triggering by rainstorm, *Nat Hazards*, 54:967-984.

Necsoiu M., & Hooper DM (2009). Use of Emerging InSAR and LiDAR Remote Sensing Technologies to Anticipate and Monitor Critical Natural Hazards, Invited Book Chapter in "*Building Safer Communities. Risk Governance, Spatial Planning and Responses to Natural Hazards*", Volume 58 NATO Science for Peace and Security, Series – E: Human and Societal Dynamics, Editor: U. Fra Paleo, August 2009, Pages 246-267.

Necsoiu M., Ronald I., McGinnis N., Donald I, Hooper M. (2014). New insights on the Salmon Falls Creek Canyon landslide complex based on geomorphological analysis and multitemporal satellite InSAR techniques, Landslides, 11(6):1141-1153 DOI 10.1007/s10346-014-0523-8.

Nolan M, Fatland DR. (2003). Penetration depth as a DInSAR observable and proxy for soil moisture. Geoscience and Remote Sensing, IEEE Transactions on. Mar;41(3):532-7.

Radulian M, Mândrescu N, Grecu B (2006). Seismic ground motion variability over the Bucharest area, *Acta Geodaetica et Geophysica Hungarica*, 41(3-4): 361-368.

Rucci A, Ferretti A, Guarnieri AM, Rocca F. (2012). Sentinel 1 SAR interferometry applications: The outlook for sub millimeter measurements. Remote Sensing of Environment. May 15;120:156-63.

Sarkar S, Kanungo DP. (2004). An integrated approach for landslide susceptibility mapping using remote sensing and GIS. *Photo Eng Remote Sens* 70:617-625

Thaiyuenwong, S. and Maireang, W. (2010). Triggered-Rainfall Landslide Hazard Prediction, Research and Development J., 21, 2, 43-50.

UN – ISDR (2004). *Living with Risk. A Global Review of Disaster Reduction Initiatives*. United Nations, Geneva, p. 430. http://www.unisdr.org/eng/about_ isdr/bd-lwr-2004-eng.htm (accessed 12 November 2011).

GeoPatterns, Vol. III, Issue 1, April 2017, pp. 13-17

Navigating through historic Danube maps: a look at the fluvial islets between Giurgiu and Oltenita towns

Andreea-Florentina Marin
Faculty of Geography, University of Bucharest
andreea.marin09@yahoo.com

Abstract. This paper presents a cartographical retrospective of the most relevant maps for the Danube River, focusing on the fluvial islets. The study area corresponds to the Giurgiu-Oltenita sector, one of the Danube's sectors displaying a relative stability regarding the number of such geomorphological landforms. If by the end of the 17th and the beginning of the 18th centuries the Danube River was drawn as a straight, wavy or curly lines, after this period the maps were made more detailed and precise, also depicting its fluvial islets and marshes. At the same time, information about the navigation, vegetation, topography and bathymetry is starting to be collected and mentioned. All these maps and aerial/satellite images provide an excellent record of historical locations and configuration of the Danube course and its islets.

Keywords: *historical cartography, old maps, fluvial islets, Danube River*

1. INTRODUCTION

Historical maps are an important source of data and information for identifying, locating and studying the evolution of the geographical elements. So, in this paper we propose a cartographical retrospective of the most relevant maps for the Danube River, focusing on the fluvial islets. Because this research is a part of my PhD Thesis, we'll explore and identify the Danube's islets between Giurgiu and Oltenita towns (this being the area of my analysis).

My cartographic research on the Danube's fluvial islets involved searching, identifying and selecting all the relevant historical maps found in different libraries. In that regard, the most maps were consulted from the collection of The Maps Department from the Romanian Academy Library. Also, some of them were taken or bought from different virtual libraries. It's important to mention the portal of the National Library of France, which provides free access to a colection of public domain maps and the Europeana Collections – a European Digital Library for all, which offers a huge collection of books, journals, films, photos, old maps, etc.

A remarkable project which lead to the digitalization, georeferencing and the online publishing of Szathmari's map should be noted. The initiative was conducted by a team of specialists from Babes-Bolyai University from Cluj, coordinated by Professor Bartos-Elekes Zsombor.

Also, the website of the geo-spatial.org community is an online resource for enthusiasts of old maps.

At the same time, my cartographic research was complete with a visit to the National Museum of Maps and Old Books from Bucharest (Romania).

2. DANUBE COURSE FROM ANTIQUITY UNTIL THE EARLY 17th CENTURY

The first mathematical descriptions of the Danube was made in *Ptolemy's Geography*. He used latitude and longitude for positioning (Constantinescu, 2014). But the oldest and successful map of Ancient Dacia, including the Danube course, is *Tabula Peutingeriana* (Figure 1). It's the first map that depicts the Danube's islets.

Also, it should be noted the works of the authors: Isidorus of Seville, Abraham Ortelius, Gerard Mercator and Nicolas Sanson D'Abbeville.

What is significant for this period is that the Danube course was drawn elusively through straight, wavy or curly lines.

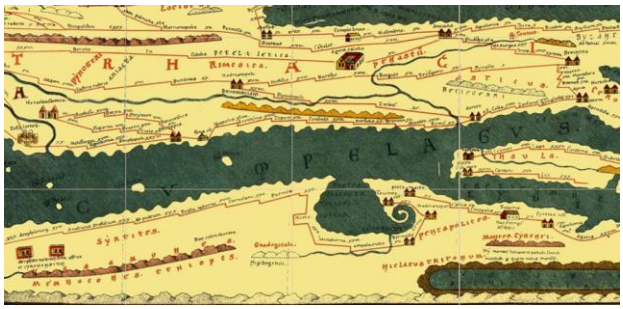


Figure 1 *Fragment of Tabula Peutingeriana*
Source: http://www.tabula-peutingeriana.de/

3. MAPS OF THE DANUBE COURSE IN THE 18th -19th CENTURIES

At the beginning of the 18th century, Constantin Cantacuzino draws up the first map of the Wallachia. This is one of the most detailed, complete and accurate maps made up to that time. It was engraved in 1700, in Padova (Italy) and highlights the territory "between Carpathians and Danube River and from Siret to near Cerna Valley, including portions from Dobrogea, Moldova, Transylvania and Banat" (Popescu-Spinteni, 1978). Along the Danube River are mentioned 18 islets of which 3 are located in the study area (Figure 2). Based on the map drawn up by Constantin Cantacuzino, several copies were made, including: a map executed by Shierendorff (in 1707) and the map drawn up by Anton Maria Del Chiaro (in 1718). Unlike the original map, the version of A.M. Del Chiaro lacks some geographic features such as the river islets situated to the East of the Olt River's Mouth.

Contemporary with the map created by Anton Mara Del Chiaro is the map drawn up by Marsigli. He has conducted a series of research on the Danube River, executing a map of the river between Kahlenburg and Ruse cities; as such, it doesn't include the Danubian sector under study.

Figure 2 *Fragment from a map of Wallachia drawn up by Shierendorff, containing the Danube's islets between Giurgiu and Oltenita*
Source:https://ro.wikipedia.org/wiki/Harta_%C8%9A%C4%83rii_Rom%C3%A2ne%C8%99ti_-_Constantin_Cantacuzino#/media/File:Cantacuzino_1707.jpg

Throughout the 18th and the 19th centuries, Eastern Europe has been affected by various conflicts between the Austro-Hungarian Empire, the Ottoman Empire and the Russian Empire (Constantinescu, 2014). Those wars led the need to hold new, detailed and accurate information about the topography of the areas where they operate. An exceptional cartographic document from this period is the map made by Captain Lauterer (Figure 3). This is the first serious attempt to represent cartographically the whole course of the Danube River. For this action, Lauterer had done several expeditions on the Danube course. After the first trip, a map was drawn between Zemlin – Rusciuc cities (11 boards at a scale of 1:100.000). In the second expedition, carried out in the summer of 1782, Lauterer completed his set of maps with boards for the Rusciuc-Sulina sector (Docan, 1912; Popescu-Spinteni, 1978; Constantinescu, 2014). Shortly, Captain Siegfried Iohannes Heribert baron de Tauferer performs a review of Lauterer's Map (Constantinescu, 2014). On Captain Lauterer's Map are depicted 22 islets between Giurgiu and Oltenita town.

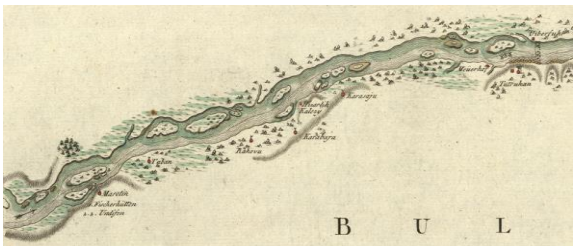


Figure 3 *Fragment from Captain Lauterer's Map containing the Danube's islets between Giurgiu and Oltenita*
Source: http://www.wildernis.eu/chart-room/?keyword=danube

This series of cartographic materials created with a relative accuracy continue with the map of Wallachia made by the Specht at a scale of 1:57,600.

Also, river islets along the Danube course appear on *Mappa specialis Valachiae* created by Josephi Dirwaldt (1810) and on *Generalcharte der Walachey nach allen vorhandenen Hilfsmitteln bearbeitet und gezeichnet* drawn up by Franz Fried (1811). General Frédéric Guillaume is the author of *Carte générale de la Turquie d'Europe à la droite du danube ou des beglerbegliks de Roum Jli, Bosna et Morée : dressée d'après les meilleurs observations astronomiques, itinéraires, cartes particulières, & reconnaissances existantes jusqu'à ce jour / par F. Guillaume de Vaudoncourt, ... ; K. Wimberger graviert ; die Gebürge gravirt v. I. Päringer ; In Stein gravirt von A. Falger u:L. Zertahelly in München ; beschrieben und die Gebirge gravirt v. L. Zertahelly*, which dates from 1818; 17 fluvial islets appear between Giurgiu and Oltenita. Later, in 1837 Artaria&Comagnie publish *Carte du cours du Danube depuis Ulm jusqu'à son embouchure dans la mer Noire, ou Guide de voyage à Constantinople, sur le Danube avec indication de tout ce qui a rapport à la navigation des Pyroscaphes sur cette route*. On this map we have identified a total of 10 islets (Figure 4).

Figure 4 *Fragment from the map published by Artaria&Comagnie*
Source: Bibliothèque nationale de France, département Cartes et plans

We should also take notice of the Russian maps from 1835 and 1853. Even though on the map the essential element is the human settlement, we can see that the Russians gave a particular attention to Danube River. The maps show big and small islets, the ponds on both banks lakes and second channels. In our study area 14 fluvial islets appear.

From 1844 dates *The Plan of Danube Course*, executed by V. Begenaru. Created in Russian language, the maps show the islets along the Danube, as well as the marshes and towns located near the river; 22 islets are represented between Giurgiu and Oltenita towns.

In 1864 another detailed map of Wallachia was made being entitled *Charta Romaniei Meridionale* (Figure 5), but often is called after his draughtsman: Szathmári's map. This map is based on the Austrian topographic survey between 1855-1859 (Bartos-Elekes *et al.*, 2014). The map shows the Danube course, with its islets and sandy bars; 19 fluvial islets appear in the studied area.

Figure 5 *Fragment from Szathmári's map*
Source: http://www.charta1864.ro/

Subsequently, based on the Second Military Survey, a general map entitled *General-karte des Fürstenthums Walachei ausgeführt und herausgegeben durch das k.k. militärisch geografische Institut im jahre 1867* (*General map of Principality of Walachia compiled and issued by the Imperial and Royal Military Geographical Institute in the year of 1867)* was produced at the scale of 1:288,000 (Bartos-Elekes *et al.*, 2014). There was also a Romanian edition at the same scale, with the title: *Harta Ţerri Românescĭ dupe reducţia originalâ din harta ce' mare ridicate de Corpul de Geniu Geografic Austriac cu numirile correctate prin Ministerul din Intru* (*Map of Walachia after the original reduction from the large map surveyed by the Austrian Corps of Geographic Engineers with the corrected names by the Ministry of the Interior).* On both maps 17 fluvial islets appear.

The officers of the Danube Division made in 1897 a map as an atlas for Danube from Vârciorova to Brăila towns. In the Danubian sector between Giurgiu and Oltenita towns are mentioned 17 river islets.

4. DANUBE MAPS FROM THE 20th CENTURY UNTIL PRESENT

Further, the 20th century brought a cartography more precise and focusing on the Danube course.

A Danube Map from Silistra to Gura Văei executed by Sub-Lieutenant Matei Vasilescu is based on the survey from 1900. Known as the *Fluvial Islet's Map*, this was created at a scale of 1:56,500 and includes 24 sheets with 28 x 40 cm each. Our study area is represented on four sheets: N III sheet, N IV sheet, N V sheet and N VI sheet.

A few years later, Lieutenant – Colonel Mihail Drăghicescu draw up a navigation map known as *The Danube River from The Iron Gates to the Black Sea*. On this map we found 20 river islets.

After The First World War a reference cartographic document is represented by the map called "*Plan Director de Tragere*". The information on these plans is the results of several measurements from previous sources: Romanian, Austrian and Russian, and since 1924 some of them have been updated based on aerial photographs (Crăciunescu *et al.*, 2011). The Giurgiu-Oltenita sector is represented with 27 islets (Figure 6).

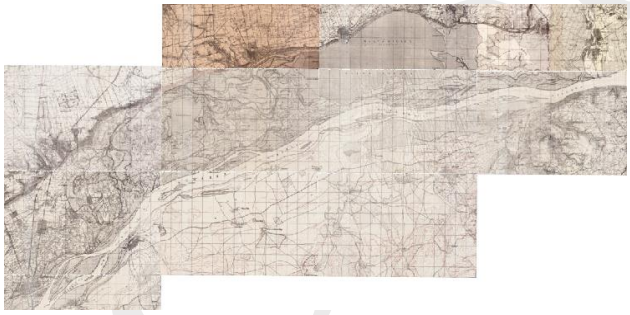


Figure 6 *Fragment from a map called "Plan Director de Tragere"*
Source: http://www.geo-spatial.org/

Another important navigation map which needs to be noted is the map created by N. Marinescu and D. Anton. *The Navigation Map of the Danube River from km 500 to Mn 73* was printed in 1962 and was based on the maps edited by the European Commision of the Danube (CED). In the Danubian sector analyzed 27 fluvial islets are mentioned.

From all maps of the 20th century, the most valuable are the Soviet Maps and, of course, the Romanian Topographical Maps made by the Military Topographic Department.

The 20th-21th centuries have brought a revolution in the cartographic science by developing new techniques such as aerial survey, remote sensing or global positioning systems. Therefore, the fluvial islets can be monitored based on different satellite images (Figure 7) or can be mapped with GPS instruments.

Figure 7 *Danube river and its islets on a Sentinel-2A image (30.07.2016)*
Source: http://sentinel-pds.s3-website.eu-central-1.amazonaws.com/

5. STATISTICAL APPROACHES

Through our research, we identify a total of 83 historical maps and satellite images, of which 36 are maps (from Antiquity Period to 20th century) and 47 are satellite images taken between 1986 – 2017 (Figure 8).

Based on maps and satellite images found for the Danube River, we can identify the number of the fluvial islets located between Giurgiu and Oltenita towns (Figure 9). It's true that the appearance on the maps of those landforms is conditioned by the scale and the precision on which they were made.

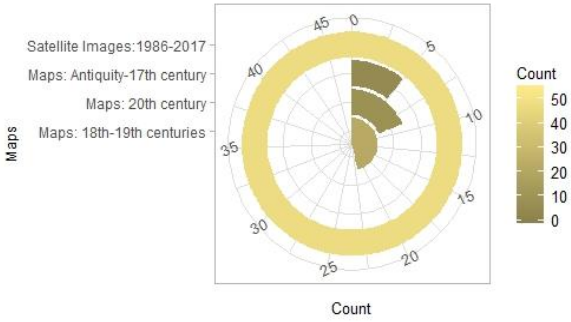


Figure 8 *The graphical representation of the count of maps and satellite images founded in our research*

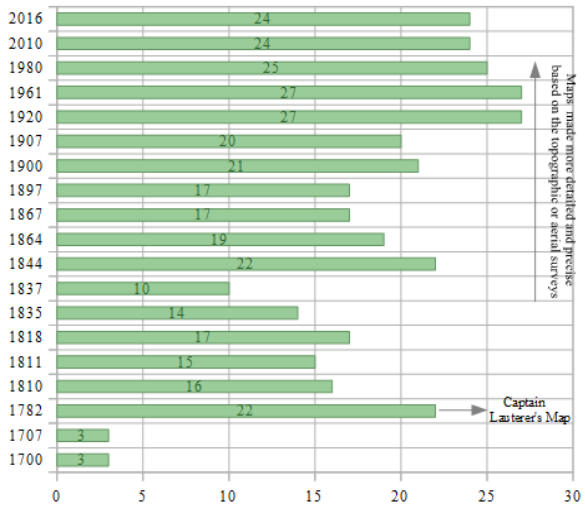


Figure 9 *The graphical representation of the total number of islets along Danube River between Giurgiu and Oltenita, founded on various maps and satellite images.*

6. CONCLUSIONS

This article presents a cartographical retrospective of the most important maps for the Danube River. We paid special attention to fluvial islets, taking as a case study the Giurgiu-Oltenita sector.

As a finding, we observed that if by the early 18th century the Danube course was drawn elusively through straight, wavy or curly lines, after this period more accurate and detailed maps appear, depicting the islets of the Danube river and its marshes and lakes. Subsequently, information about navigation is collected and mentioned, bathymetric and topographic surveys are conducted and nowadays the Danube course is monitored through satellite images and RADAR technologies.

Because we want our approach to be perfectible, we are open to all signs about other maps.

REFERENCES

Bartos-Elekes, Zs., Timar, G., Imecs, Z., Magyari-Saska, Z. (2014). Fligely's Topographic Mapping of Walachia (1855–1859), Szathmári's Map of Southern Romania (1864), its Geo-referencing and Publishing on Web (2011–2014). In digital form: http://charta1864.ro/essay.html.

Crăciunescu, V., Rus, I., Constantinescu, Șt., Ovejanu., I, Zsombor-Bartos, E. (2012). Planurile Directoare de Tragere. Accesed online: August 1, 2016.

Crăciunescu, V.,Constantinescu, Ș., Ovejanu, I., Rus, I. (2011). Project eHarta: a collaborative initiative to digitally preserve and freely share old cartographic documents in Romania. e-Perimetron, 6(4): 261-269.

Constantinescu, St. (2014).Various approaches to the Danube Delta: from maps to reality, chapter book in The Biopolitics of the Danube Delta: Nature, History, Policies., Editors: Constantin Iordachi and Kristof van Assche, Lexington Books, ISBN 978-0-7391-9514-7.

Docan, N. (1912). Memoriu despre lucrările cartografice privitoare la războiul din 1787-1791. Librăriile Socesc and Comp. Și C. Sfetea, București.

Giurescu, C.C. (1957). Principatele Romîne la începutul secolului XIX. Editura Științifică, București.

Mihăilescu, V. (1928). Harta austriacă din 1791. Buletinul Societății Regale Române, nr 47, 366-372.

Năstase, A., Osaci, G. (2005).Topografie. Cartografie – Ediția a II-a revăzută. Editura Fundației România de Mâine, București.

Popescu-Spineni, M. (1978). România în izvoare geografice și cartografice. Editura Științifică și Enciclopedică, București.

Vâlsan, G. (1912). O fază în popularea Țărilor Românești:cu prilejul unei hărți statistice vechi descoperite în ultimul rând. Editura Socec, București.

GeoPatterns, Vol. III, Issue 1, April 2017, pp. 17-21

Relocated churches in the centre of Bucharest

Maria Bostenaru
University of Architecture and Urbanism "Ion Mincu" Bucharest

Abstract. The demolitions for the creation of the civic centre destroyed one fifth of the area of Bucharest. The destructions include a part of the architectural ambience of the streets, documented by Gheorghe Leahu for example in watercolours, important monuments such as the Brâncovenesc hospital or the Văcărești monastery. Apart of the demolitions, some monuments such as churches could be saved through relocation, an ingenuous method of the engineer Eugen Iordăchescu. This saved through relocation from their original place a number of monuments but lacking protection of the historical site. Other was demolished, the earthquake damage being abusively used as reason for the demolition. Although some religious buildings could be saved through that method, they were lacking the original monastery precinct and hidden behind blocks of flats. The boulevard of the so-called Victory of Socialism, named by some the Victory of Socialism on the city, cut the organic tissue resulting into streets transformed into dead ends of suddenly sectioned like the street of Rahova, sectioned by the boulevard, for which urban solutions are still looked for. The amplitude of the problem was clear in the international competition Bucharest 2000, won by the German office Meinhard von Gerkan. According to this solution, the monumental dimensions of the House of People could be put in scale only through the construction of some skyscrapers in the area remained park around it, where because of the rubbish from demolitions plants don't grow adequately.

Keywords: *photography, church, relocation, mapping, GIS*

OVERVIEW

Carol Pop de Szathmary (Oltean, 2012) photographed Bucharest, his adoption city, and among the most renowned pictures are those of Dealu Spirii, the demolished zone by Ceausescu. Fig. 1 shows a panorama view with some important churches, and Fig. 2 shows the monastery of Antim in the 19th century and today. The monastery of Antim was one of the affected churches by the construction ambitions of the dictator. The precinct was damaged, through the movement of the sinodal palace, a construction in new Romanian style added two centuries later. Fig. 3 shows the translation of this palace to make place for the so-called Victory of Socialism. The fate of Antim monastery was not unique. Most compelling case was that of the monastery of Mihai Voda, from the time of the Middle Ages, the voivod Mihai Viteazul, the precinct of which contained the state archives. Only the church and the tower could be saved, through a movement horizontally and vertically which needed an engineering masterpiece Iordăchescu (1996). Table 1 shows all churches which were translated in Romania, out of which six are in the zone for the new civic centre of Bucharest, as shown in Fig. 3 and 4.

Monument relocation is a problem discussed in relation with the ICOMOS documents. In the time churches were relocated in Bucharest, the only ICOMOS document touching the problem was the Venice Charter 1964, other documents with opinion on this problem being from 1990 (on the archeological heritage) and 1999 (cultural tourism) respectively. A discussion on contemporary relocations is given by (Gregory, 2008). The topic is still of interest for ICOMOS, so Ahmet Turer presented in the ISCARSAH meeting in Istanbul 19.

October 2016 the relocation of the Zenelbey Mausoleum. But the political implications of the master plan are not so deep in any of these cases.

***Figure 1**. [Imagine panoramică a Bureştiului. Vedere din Dealul Mitropoliei] ; Szathmari, Carol Popp de ; 1812-1887. Part of a photographic album- topographical mark Af 187 - with hand-written title page in black ink and watercolor, with dedication to Elena Cuza: "Souvenir de la Roumanie dedié a son Alteesse Serenissime Helene Principesse Regnante de la Roumanie par Charles Pap de Szathmari peintre et photographe de la Cour de Son Altesse Serenissime le prince Regnant et decoré par LL. MM. L'Empereur d'Autriche, de Russie, du Sultan, Le Reine Victoria et le Roi de Würtemberg". The album is bound in turtle shell covers, with gold and silver inlay on the first cover, with gilded-edged pages and silver bolt. It comprises 55 photographies from the no. 66276 to 66321. Approximate date of the album:1860. The photography has a legend above, hand-written in black ink. Vedere din Dealul Mitropoliei. 1. Biserica Sfântul Antim 2. Mânăstire, spital 3.[Biserica] Sfinţii Apostoli 4. Foişor 5.[Biserica] Sfântul Ilie 6. Palatul Brâncovenesc 13.[Biserica] Sfânta Vineri 14. Palatul Bibescu 15. Drumul Mitropoliei 16. Biserica Sfântul Luca 17.[Biserica] Radu Vodă 18.[Biserica] Sfântul Spiridon 19.[Biserica] Sfânta Ecaterina 20. Arhivele Statului 21. Drumul Văcăreştior 22. [Biserica] Sfânta Troiţă.*

a

b

***Figure 2.** a. The Church of Antim Monastery, Bucharest. Szathmari, Carol Popp de ; 1812-1887. The photophraphy belongs to the photographic album titled: 'România', as results from the inscriptions on its title page: ROMÂNIA.//ALBUM//I.S. Domnitorulŭ Romanilor//CAROL 1//Photographiat din ordinulŭ I. S. dupa natura de //C. P. SZATHMÁRI//Pictor şi Photograph I. S. Domnitoruluì//BUCUREST.//[1867]. The album comprises 42 photographies, from no. 8386 to no. 8426 and 57677. The photography is framed in a black-inked border. A printed note, above: ROMANIA ALBUM ALŬ M. S. DOMNITORIULŬ CAROLŬ 1., down centre, in black ink: ANTIM BUCURESCI. Biblioteca Centrală din Bucureşti. 1901. Photography from Europeana database, public domain. b. The church today photo M. Bostenaru, 2016.*

Table 1. Translation of churches

	Translated churches	Year constructed	Year translated	Distance
1	Schitul Maicilor church	1726	1982	245m
2	Olari church	1758	1983	
3	Saint Ilie Rahova church	1838	1984	51m
4	New Ioan church Unirii place	1774	1986	23m
5	“Capra” Pantelimon road church	1877	1986	90m
6	Saint Stefan “Cuibul cu barza” church	1760	1988	16m
7	Mihai Voda church	1594	1985	289m/6m
8	Sinod’s palace at Antim church	1912 (1715)	1985	
9	The statue of Domnita Balasa at the corresponding church	1885	1988	
10	A church in Resita		1985	
11	Church in Rimeti		1988	

The reason was to cover the churches by the newly raised blocks, as seen in Fig. 5. This way, the panorama which we saw in Szathmary's picture would be covered. A proposal for further research is to sketch the silhouettes in this panorama for 3D reconstruction as for the pre1755 earthquake Azulejos panorama in Lisbon (Bostenaru Dan *et al*., 2013). Modern digital geographic tools build a possibility for analysis of the images, and as such the GPS added image of the map before could allow identifying the changes in a swipe map (Fig. 3). The research on 3D models and databases has to be seen in connection with another research we are doing, on the lost heritage of Magheru boulevard (Bostenaru *et al*., 2013).

The translation of churches was a mean to save the churches by the construction ambitions of the dictator. Eugen Iordăchescu patented the method and recently several exhibitions were dedicated to this, in Brăila, Bucharest and Venice (Fig. 6). The exhibitions were accompanied by the launch of the Trinitas TV documentary DVD [7]. The translation of buildings continues to raise attention internationally, for example the meeting of the ICOMOS committee of ISCARSAH is dealing with historic Zeynelbey Mausoleum in Hasankeyf Batman (1100 tons about 2 km distance using SPMT as a consequence of a dam). In case of the totalitarian regime translation meant saving the churches, as over 20 were demolished, but today's approach in the context of authenticity needs consideration. The context of the neighbourhoods along the so-called Victoria Socialismului, presented in the watercolours of Gheorghe Leahu (1995) was broken, and projects were made to re-establish it (Enache *et al*., 2013).

We used ArcGIS online to reconstruct the was the churches were translated, through swipe maps and story maps, and also superposed the original drawings from 1974 with the current GIS map of Bucharest. This way geographic mapping can reflect changes induced by the master plan. Further works will concentrate on working with the imagery including that of Szathmary (Ionescu, 2014, Ciupei, 2013). The method of Bostenaru et al (2013) can be applied to the silhouettes in the photography similarly to those of Lisbon pre1755 azulejos.

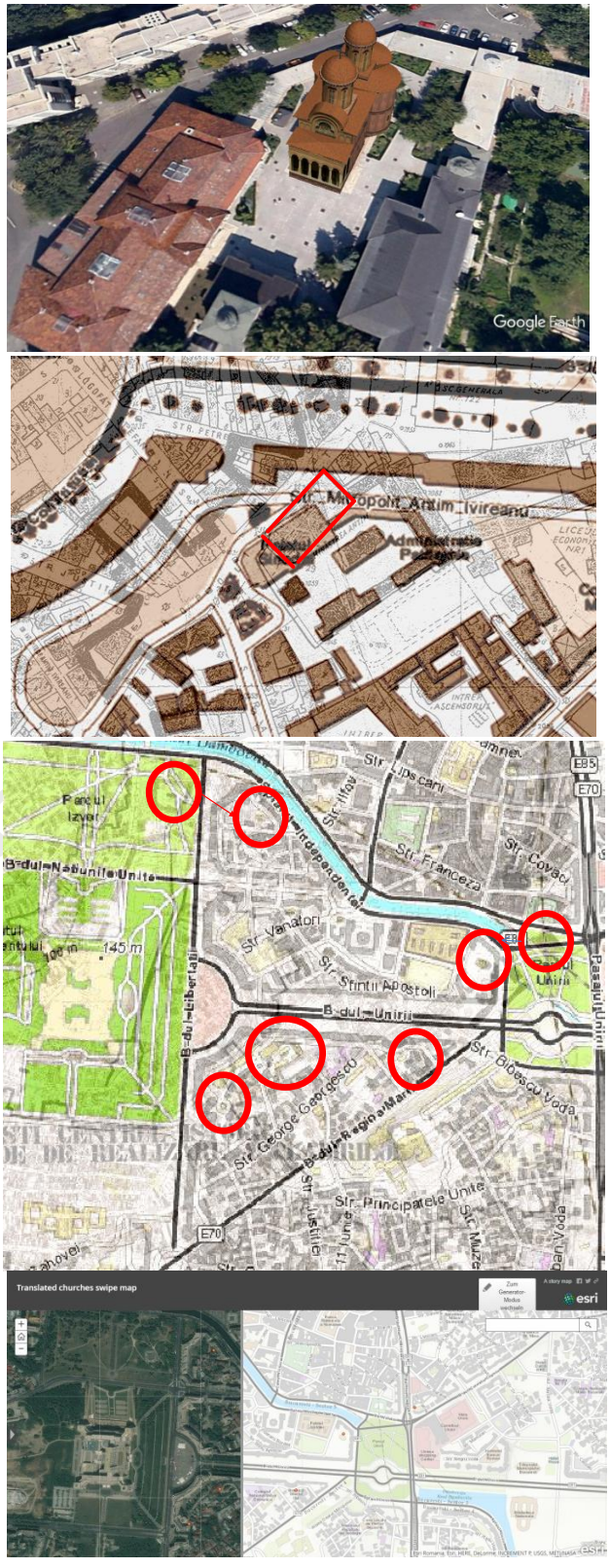


Figure 3. *Superposition of maps before (1974) and after demolitions and translations (today, Esri Romania, Esri, HERE, DeLorme, INCREMENT P, USGS, METI/NASA) for Antim monastery and the whole zone. 3D model of Antim monastery (c) Google Earth. Swipe map. http://arcg.is/2dH86eF*

***Figure 4**. Story map of translated churches. http://arcg.is/2dcM8jH*

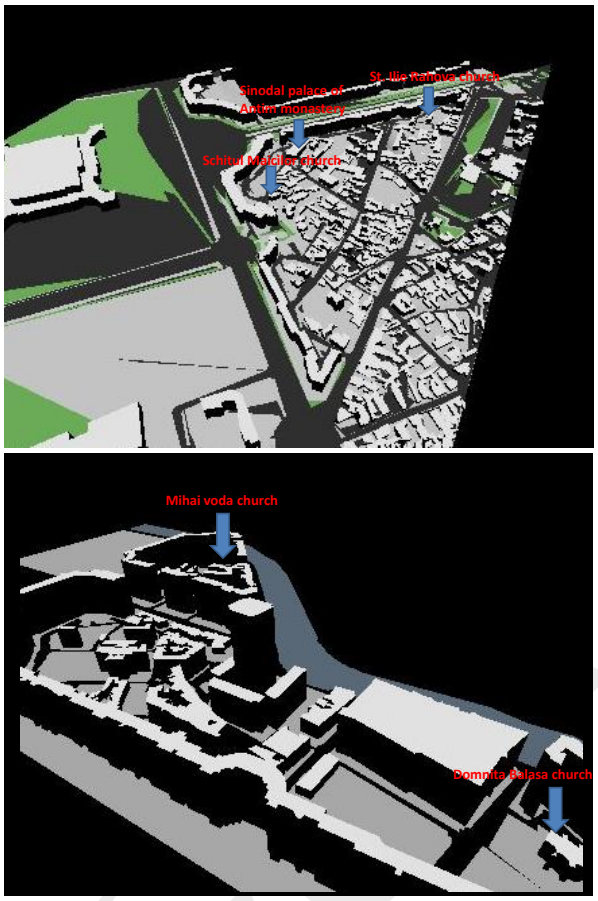


***Figure 5**. Position of the translated churches in the current civic centre. New markings on 3D models in Adobe director after CAD models (students in the course Protection of localities against risks)*

ACKNOWLEDGEMENTS

The author would like to acknowledge the Vasile Pârvan fellowship at the Accademia di Romania a Roma which included also a visit to Venice to see the exhibition. The author is also grateful to the COST action TD1406 "Intelligent management of heritage buildings" for the short term scientific mission at the Karlsruhe Institute of Technology for funding of exchange on this research.

***Figure 6.** Exhibition dedicated to Eugen Iordachescu's translation of churches at the ICR in Venice.*

REFERENCES

Bostenaru-Dan, M., Panagopoulos, T., Gociman, C. O., Armas, I., Dill, A., Chiriloae, A., and Florescu, T. (2013), The impact of hazards on the urban tissue – 3-D representation and digital databases, Adv. Geosci., 35, 45-53, doi:10.5194/adgeo-35-45-2013.

Ciupei, L. (2013), Carol Szathmári: monographic references and photojournalism, PhD thesis, Babeş-Bolyai University of Cluj-Napoca

Enache, C., Bostenaru Dan, M., Tanase, G., Matroz, A., Pitulicu, L., Chiriloae, A., Costache, I., Milea, V., Stoica, A., Titiriga, A., Gociman, C. O., Florescu, T., Buzila, C. (2013), Redemptive landscapes in central area of Bucharest, zone destructured in the communist time with the erection of the "People's House" (Parliament Palace) student projects, Le Notre Landscape Forum Rome 2013, poster no. 99, in: Rome's Landscape. LE:NOTRE Landscape Forum 2013. Edited by: Richard Stiles, Sabine Bouche-Pillon, Marlies Brinkhuijsen, Jeroen de Vries, Fabio Di Carlo, Ellen Fetzer, Harlind Libbrecht, Gabriela Maksymiuk, Sophia Meeres, Frederico Meireles Rodrigues, Le Notre, Vienna, p. 302-303

Gregory, J. (2008) 'Reconsidering Relocated Buildings: ICOMOS, Authenticity and Mass Relocation', International Journal of Heritage Studies, 14:2, 112–130. DOI: 10.1080/13527250701844027

Ionescu, A. S. (2014), Szathmári. Pionier al fotografiei și contemporanii săi / Pioneering Photographer and his Contemporaries, Oscar Print, București.

Iordăchescu, E. (1996), Translația construcțiilor, Ed. Tehnică, București.

Leahu, Gh. (1995), Bucureștiul dispărut, Editura Arta Grafică, Bucuresti.

Oltean, R. (2012), Carol Szathmary, fotograful Bucureștilor, Ed. Art Historia, București.

Trinitas TV documentary (2016).

GeoPatterns, Vol. III, Issue 1, April 2017, pp. 22-25

Methods of decision under certainty in applied emergency management

Ing. drd. Alexandru IFRIM[1]
Ec. Raluca GHIMAN[2]
Ph. Dr. Irinel Alexandru PRECUP[3]
[1]University "Lucian Blaga" of Sibiu, Faculty of Economics,
Ifrim_79@yahoo.com
[2]Academy of Economic Studies Bucharest,
raluca_ghiman@yahoo.com
[3]Inspectorate for emergency situations in Bucharest and Ilfov,
precupirinel@yahoo.com

Abstract. The present study shows how to develop information used during the decision-making process regarding procurement of equipment necessary to manage an emergency situation produced by floods.

Moments method or Deutch-Martin method applies in case of decision making problems for which the criteria are equally important. The method has as a first step the normalization of consequences matrix. This method was used to analyse the purchasing of equipment for intervention in case of some major flooding events.

Use of moments method optimally generates some clear results on procurement of goods and services that can be used in practice by the skilled professionals for emergency situations services.

Keywords: *Moments method or Deutch-Martin method, services for emergency situations, consequences matrix, normalized matrix*

1. INTRODUCTION

Emergency situations management also ensures coordination through improved management mechanisms, human resources, materials, financial and otherwise, necessary to prevent and manage emergency situations, such as restoring the normal state.

The manager in an emergency situations department needs, as well as any manager, knowledge on decision making theory that can help him with decisions deemed scientifically fair.

To decide, the manager (the decision maker) must possess knowledge, data and information relevant to the analysed situation.

At the same extent, managers must incorporate empirical evidence resulted from practice, as well as from scientific data.

Certainty characterizes types of decision situation in which influencing factors are known, have only one condition, controllable, which determine as consequences of the decision to be certainly known.

However, there are several difficulties that can arise even in certain situations, referring to:

a. Identifying the parameters that have a significance for the type of situation that is under review;

b. Identifying the parameters values considered for each element to be analysed;

c. Impossibility of comparing the contribution of different parameters in the evolution of processes, as long as they designate physical entities that are not part of the same class.

We will further present how to analyse the information that we use during the decision-making

process for procurement of some equipment necessary to manage an emergency situation produced by floods.

2. DECISION UNDER CERTAINTY

The most used analytical calculation methods are the following:

a. ELECTRE method (Andriciu R., *et al*., 2008, Căruţaşu, V- 2014);
b. TORQUE method (Căruţaşu, V- 2014);
c. LINEAR ASSIGNING method (Andriciu R., *et al.*, 2008, Căruţaşu, V- 2014);
d. Modified ELECTRE method – method that facilitates ranking of alternatives (Căruţaşu, V- 2014).

All methods that have as a first step normalization of consequences matrix are described below.

Suppose there are available n variants, their assemblage being V = {V1, V2, ..., Vi, ..., Vn} and m evaluation criteria, their assemblage being C = {C1, C2, ..., Cj, ..., Cm}.

Definition 1 (Căruţaşu, V- 2014). The assumption is that Vi alternative in relation with the Cj criterion are known values indicated in the matrix as aij. These values are written in a matrix that is called the matrix of consequences, as presented below:

	C_1	$C2$	.....	C_j	.....	C_m
	max/mi	*max/mi*	.....	*max/mi*	.....	*max/mi*
V_1	a_{11}	a_{12}	.....	a_{1i}	.....	a_{1m}
V_2	a_{21}	a_{22}	.....	a_{2i}	.....	a_{2m}
.....	.....	.....	.....	.....	.....	.....
V_i	a_{i1}	a_{i2}	.....	a_{ij}	.....	a_{im}
.....	.....	.....	.....	.....	.....	.....
V_n	a_{n1}	a_{n2}	.....	a_{nj}	.....	a_{nm}

An important notion which is found through the stages of decision optimization and ranking of alternatives for many methods is introduced below.

Definition 2. (Căruţaşu, V- 2014)**.** The Matrix marked with $(r_{ij})_{\substack{i\in\overline{1,n}\\ j\in\overline{1,m}}}$ is determined as shown below:

- for a minimum criterion, the normalized values of the matrix are calculated with:

$$r_{ij} = \frac{a_{j\,max} - a_{ij}}{a_{j\,max} - a_{j\,min}} \qquad (1)$$

- for a maximum criterion, the normalized values of the matrix are calculated with:

$$r_{ij} = \frac{a_{ij} - a_{j\,min}}{a_{j\,max} - a_{j\,min}} \qquad (2)$$

where:

- a_{ij} is the element of consequences matrix corresponding to *i* mission and to *j* criterion;
- a_{jmax} is the highest value from the consequences matrix corresponding to *j* criterion;
- a_{jmin} is the lowest value from the consequences matrix corresponding to *j* criterion, it is called *normalized matrix* attached to the consequences matrix.

Observation 1. The normalization operation is essential for many decision-making methods under certainty conditions. It aims for the uniformity of measuring units where they are determined by the alternative values for the criteria used in the evaluation.

We will further present the **Torque method or Deutch-Martin** method (Căruţaşu 2014) that applies in case of decision making problems for which the criteria are equally important.

Suppose that the normalized matrix attached to consequences matrix is the one in the table below.

	C_1	$C2$	.....	C_j	.....	C_m
V_1	r_{11}	r_{12}	.....	r_{1i}	.....	r_{1m}
V_2	r_{21}	r_{22}	.....	r_{2i}	.....	r_{2m}
.....	.....	.....	.....	.....	.....	.....
V_i	r_{i1}	r_{i2}	.....	r_{ij}	.....	r_{im}
.....	.....	.....	.....	.....	.....	.....
V_n	r_{n1}	r_{n2}	.....	r_{nj}	.....	r_{nm}

Torque method involves the following steps:

Step 1. **C**alculate the moments corresponding to each line from the normalized matrix using the following formula (Căruţaşu 2014):

$$M_j^1 = \frac{\sum_{i=1}^{n} j * r_{ij}}{\sum_{j=1}^{m} r_{ij}}\ ,\ i = \overline{1,n}, \qquad (3)$$

and rearranges the lines of the normalized matrix in ascending order of the values for the obtained moments.

Step 2. **C**alculate the moments for each column of the new matrix (Căruţaşu 2014):

$$M_j^1 = \frac{\sum_{i=1}^{m} i * r_{ij}}{\sum_{i=1}^{m} r_{ij}}\ ,\ j = \overline{1,m}, \qquad (4)$$

and rearrange the columns of the new matrix in ascending order of the values for the obtained moments.

Step 3. Repeat the operations from step 1 to 2 until applied relations (3) and (4) do not make changes.

3. ANALYSIS OF THE DECISION IN CERTAINTY CONDITIONS USING TORQUE METHOD

For analysis, four types of drainage pumps to be purchased for the intervention in the event of flooding are considered, based on the following criteria: flow rate, maximum height of discharge, fuel consumption and total cost. All these criteria are listed in the consequences matrix below:

a) C1 – flow rate (mc/h);
b) C2 – maximum discharge height (m);
c) C3 – fuel consumption (l/h);
d) C4 – total cost (lei).

We determined the normalized matrix, using the ratios (1) and (2), which resulted in the following matrix:

Calculate the moments corresponding to the lines of normalized matrix:

M1 = (1 • 0,46 + 2 • 0,67+ 3 • 0,77 + 4 • 0,82)/(0,46 + 0,67 + 0,77 + 0,82) = 2,71;
M2 = (1 • 1 + 2 • 1 + 3 • 0 + 4 • 0)/(1 + 1 + 0 + 0) = 1,5;
M3 = (1 • 0,08 + 2 • 0,17+ 3 • 1 + 4 • 0,94)/(0,08+ 0,17 + 1 + 0,94) = 3.28;
M4 = (1 • 0 + 2 • 0 + 3 • 1 + 4 • 1)/(0 + 0 + 1 + 1) = 3,5.

The normalized matrix lines will be rearranged in ascending order, according to the values of the moments previously determined, as follows:

	C1	*C2*	*C3*	*C4*
	max	***max***	***min***	***min***
V2	1	1	0	0
V1	0.46	0.67	0.77	0.82
V3	0.08	0.17	1	0.94
V4	0	0	1	1

Further we calculated the moments on corresponding column of the matrix obtained after rearranging the lines.

M1 = (1 • 1 + 2 • 0,46 + 3 • 0,08 + 4 • 0)/(1 + 0,46 + 0,08 + 0) = 1,40;
M2 = (1 • 1 + 2 • 0,67 + 3 • 0,17 + 4 • 0)/(1 + 0,67 + 0,17 + 0) = 1,54;
M3 = (1 • 0 + 2 • 0,77+ 3 • 1 + 4 • 1)/(0+ 0,77 + 1 + 1) = 3,08;
M4 = (1 • 0 + 2 • 0,82 + 3 • 0,94 + 4 • 1)/(0 + 0,82 + 0,94 + 1) = 3,06.

	C1	*C2*	*C3*	*C4*
	max	***max***	***min***	***min***
V1	65	26	1,5	1500
V2	100	30	2,5	5000
V3	40	20	1,2	1000
V4	35	18	1,2	750

	C1	*C2*	*C3*	*C4*
	max	***max***	***min***	***min***
V1	0,46	0,67	0,77	0,82
V2	1	1	0	0
V3	0,08	0,17	1	0,94
V4	0	0	1	1

The columns of the previous matrix will be rearranged in ascending order, according to the values of the moments previously determined, as follows:

	C1	*C2*	*C4*	*C3*
	max	***max***	***min***	***min***
V2	1	1	0	0
V1	0.46	0.67	0.82	0.77
V3	0.08	0.17	0.94	1
V4	0	0	1	1

We will continue these steps when calculating the moments per lines for the last obtained matrix.

M1 = (1 • 1 + 2 • 1 + 3 • 0 + 4 • 0)/(1 + 1 + 0+ 0) = 1,5;
M2 = (1 • 0,46 + 2 • 0,67 + 3 • 0,82 + 4 • 0,77)/(0,46 + 0,67 + 0,82 + 0,77) = 2,69;
M3 = (1 • 0,08 + 2 • 0,17 + 3 • 0,94 + 4 • 1)/(0,08 + 0,17 + 0,94 + 1) = 3,30;
M4 = (1 • 0 + 2 • 0 + 3 • 1 + 4 • 1)/(0 + 0 + 1 + 1) = 3,5.

The matrix doesn't change the lines, it remains as in the above situation, as follows:

	C1	*C2*	*C4*	*C3*
	max	***max***	***min***	***min***
V2	1	1	0	0
V1	0.46	0.67	0.82	0.77
V3	0.08	0.17	0.94	1
V4	0	0	1	1

The next step is to calculate the moments per column of the above matrix:

M1 = (1 • 1 + 2 • 0,46 + 3 • 0,08 + 4 • 0)/(1 + 0,46 + 0,08 + 0) = 1,40;
M2 = (1 • 1 + 2 • 0,67 + 3 • 0,17 + 4 • 0)/(1 + 0,67 + 0,17 + 0) = 1,54;
M3 = (1 • 0 + 2 • 0,82 + 3 • 0,94 + 4 • 1)/(0 + 0,82 + 0,94 + 1) = 3,06.
M4 = (1 • 0 + 2 • 0,77+ 3 • 1 + 4 • 1)/(0+ 0,77 + 1 + 1) = 3,08.

Since the columns do not suffer any permutations means that the last obtained matrix doesn't change when we applied steps 1 and 2 of the algorithm, therefore, version V2 is optimal.

4. INTERPRETATION OF RESULTS

Our objective is to identify and characterize the common area of the two processes: decision and selection.

"Torque method" applies the algorithm elaborated by S.B. Deutch and J.J. Martin (Căruţaşu, V- 2014, Trandafir R., 2004) and lends itself both for solving group decision making problems, including those which are multidimensional.

For the above example, the calculations show the following aspects:

✓ The quality of the purchased product is given by its technical characteristics when the cost of acquisition doesn't matter;

✓ Important criteria (maximum) are the flow of the motor pump (C1) and the maximum discharge height (C2). The value of normalized matrix for the maximum criterion is calculated with the ratio (2);

✓ The minimum criteria are fuel consumption (C3) and the total cost (C2). The value of normalized matrix for the minimum criterion is calculated with the ratio (1).

The problem is that there are no rules by which to establish the most important criterion, it largely depends on the budget.

Our objective is to identify and characterize the common area of the two processes: decision and selection.

5. CONCLUSIONS

In conclusion, the use of some algorithms to optimize the decision-making process begins with choosing the variants for the statistical study of the characteristics of goods and services. The torque methods are useful tools in the field of emergency situations management to find solutions in all stages of goods and services procurement. Knowing the decision theory broadens the horizon of the manager, allows him/her to better target the specific situation and to choose a scientific solution.

This method can be applied to rank or to compare products, services, activities that have similar utility, establish their criteria and their weights, an essential part in the study of alternatives or variants.

Using the torque method optimally generates obtaining some clear results on procurement of goods and services.

REFERENCES

Andriciuc R., Barbu D., Petre D., Evaluarea cantitativă în deciziile privind situaţiile de urgenţă civilă, Editura ERICOM, Bucureşti, 2008.

Căruţaşu, V., Matematici aplicate în management, Sibiu, Editura „ADALEX", 2006.

Căruţaşu, V., Cercetări operaționale și teoria deciziei, Sibiu, Editura Academiei Forțelor Terestre, 2014.

Căruţaşu, V., Răchiţan, D., Variabile aleatoare şi aplicaţii, Sibiu, Editura Universităţii „Lucian Blaga", 2000.

Dobre, I., Bădescu, A.V., Păuna, L., Teoria deciziei, Bucureşti, Editura Academiei de Studii Economice, 2007.

Trandafir, R., Modele şi algoritmi de optimizare, Bucureşti, Editura AGIR, 2004.

GeoPatterns, Vol. III, Issue 1, April 2017, pp. 26-30

Earthquake emergency plan analysis; a case study of Bacău County in Romania

Radu Ionescu
University of Bucharest, Romania
radu.ionescu@geo.unibuc.ro

Abstract. The work is structured as follows: First, it will briefly talk about an emergency plan's function and structure. From this starting point the article will move on to the actual plan and highlight some of its major deficiencies. Special attention will be given to why having a model plan is a bad idea and to the link between emergency plans and policy/legislative context. In the end, a couple of the plan's strong points will be discussed. The main point to be drawn from this plan's analysis is that focusing on the policy and the deadlines it imposes without taking in to account local limitations leads to hastily, mass-produced plans, which are far removed from the recommended planning process.

Keywords: *Integrated Emergency Management, emergency planning, earthquake planning, landslide planning, emergency plan analysis*

1. INTRODUCTION

This essay will focus on the proliferation of a model/template emergency plan by the Bacău County (Romania) Emergency Committee. The plan has a main body and a series of annexes. It overtly states that local authorities should keep the main body, fill in the annexes and consider the resulting document as their emergency plan!

The function of emergency planning is to prepare government, organizations and people for emergencies and disasters. This preparedness allows resources to be used appropriately to reduce vulnerability. Both resources and vulnerability change in time so the planning process has to keep track of these changes if it is to achieve its goal. The emergency plan, as a document, is a picture of the planning process at one given time (Alexander, 2002; Coppola, 2007; Perry and Lindell, 2007; WHO, 1999; Twigg, 2004; Lindell and Perry, 1992; Lindell *et al*., 2007, Alexander, 1993).

A plan should be structured around four main concepts: strategy (how to address the issue), tactics (what tools and actions are used to implement the strategy), responsibilities (who executes the strategy), and resources (manpower, hardware, information) (Perry and Lindell, 2007; Lindell *et al*., 2007).

One of the main critiques concerning emergency plans is that people do not follow them in case of an emergency. Even if that might sometimes be the case they are nevertheless a tool for problem solving and education (WHO, 1999).

2. PLAN ANALYSIS

The plan discussed in this essay is titled "The defence plan in case of a specific emergency situation caused by earthquakes and/or landslides". It is 38 pages long. Half of the plan represents the body of the plan (purpose, responsibilities, a vast section on mitigation activities, etc.). The other half is made up of annexes. These annexes are essentially empty tables concerning things like buildings that are at risk, resources or who is responsible for gas/ electricity/water. The plan states that local authorities should keep the main body, fill in the annexes and consider the resulting document as their emergency plan.

Putting earthquakes and landslides in the same emergency plan (which is to be used as a model

plan) is debatable. Maybe it was done because they both involve the same set of strategies (Alexander, 2002; Perry and Lindell, 2007) or maybe it was done just to save time and minimize workload. Onești is the second largest city in Bacău County with circa 50.000 inhabitants. The author fails to see how this city situated in a relatively flat valley should share the main body of an earthquake and/or landslide plan with Slănic Moldova (a 5000 – inhabitant's town perched on mountain sides). It seems less a case of similar strategies and more a case of "two-in-one" irrespective of context and local dimensions.

Going further with the plan's analysis one can notice it is riddled with errors. It has no legislative framework. One has to research if the county is at risk from earthquakes because there is no supporting evidence. It has no links to supporting plans. The plan becomes active by employing „parameters" (number of dead/ wounded/ homeless) for what is to be considered a specific emergency without factoring in the size of the administrative unit. There is no mention or apparent understanding of how the plan will work over prolonged periods. There is no identified process for learning lessons as a result of an emergency. There is no maintenance policy and no stand down procedure. It has considered informing and warning the public but not media relations or staff support (UK Cabinet Office, 2011; Alexander, 2002; Perry and Lindell, 2007; Lindell and Perry, 1992; Lindell *et al*., 2007).

All of these errors are potentially life-threatening but the paper will focus on what is seen as the plan's underlying issue. It is a model plan. Not only does this make it generally useless (Perry and Lindell, 2007) but it amplifies and propagates its limitations. Even if the plan were very good when evaluated against official guidance or academic texts (which it isn't) it is not a good idea to base local community emergency plans on a template.

There are a number of reasons for this.

The first should do with the hazard. Even if different towns in Bacău County are to be affected by the same earthquake the way the hazard manifests itself will be unique for each of the towns (Perry and Lindell, 2007). Soft sediments increase the probability of seismic structural damage which means that apparently similar towns will feel the impact differently depending on the soil they're built on (Alexander, 1999).

The second has to do with vulnerability (Bankoff *et al.*, 2004, Wisner *et al.*, 2004). Counting the buildings that are in danger of collapse should an earthquake occur and listing them does little in assessing the communities' specific vulnerabilities. Slănic Moldova (the small town mentioned earlier), has one access road and is surrounded by mountains. (Bakuli and Smith, 1996). Dărmănești (a town of about 15.000) is downstream from a dam (Bayraktar and Kartal, 2010; Pidd *et al.*, 1996) and the lake behind it containing 90 million cubic meters of water (BCC, 2010). The vulnerability assessment needs to match the community.

The third has to do with the interaction between planners. Planning is an opportunity for liaison, joint problem solving, consultation and education (Alexander, 2002; LESLP, 2007). If this is taken away then acceptance and support (French, 2011) of the „outsider" plan will be diminished.

Planning should not be about having a written plan; it should be about community preparedness. Even so one could see how using a model plan might make things easier and faster and therefore tempting (Perry and Lindell, 2007). It is just that in this case it wasn't local planners that chose to use a template for their community but it was the County Committee that imposed a model upon Local Committees.

In 2004 the Romanian Government issued an ordinance that modified the structures in place at the time and created the National Emergency Management System (Romanian Government, 2004). In this system mayors and prefects need to set up Local Emergency Committees and County Emergency Committees respectively [these are similar in function and structure to the Local Resilience Forums (UK Cabinet Office, 2011) in the UK]. At a national level the Ministry of Internal Affairs coordinates. All committees are obligated by law to have emergency plans for specific risks, evacuation plans and intervention and cooperation plans.

So if Local has to write its plans why is County doing the job for them? There are probably numerous inter-connected reasons but the essay will only focus on the interaction between two:

centralization (Walter and Bruch, 2010; Baldassarri and Grossman, 2011) and political pressure.

In 2004 Romania was being pressured by the EU to make structural reforms (Babetskii and Campos, 2007) so that it can successfully join in 2007. At a central level where resources are abundant the pressure of reforms can be overcome. At a local level, where resources (including trained people) may be quite limited (Rockett, 1994), reform (and the documents to prove it) might be slow to come. Because of centralization counties get their financial support from Central, so if Central needs documents from Local to prove to the EU that reforms are on schedule, County has to "help" Local because they know/assume Local will not deliver on time.

Apart from this generating almost useless emergency plans and creating an illusion of safety there is also another issue which is that policy should be widely debated (WHO, 1999), but it isn't. Policy should also be developed in consultation with those who are required to implement it; this again is not the case here. If everybody has produced the documents that they were required within the deadlines the need for debate moves in the background.

Planning for disaster with multiple organisations and jurisdictions is hard enough (Georgiadou, 2010, Hill, 2010) because various stakeholders might have different perspectives and/or goals (French, 2011, Mitchell, 1997). Adding top-down political pressure (Rockett, 1994) and a centralized system of governance (Blagescu *et al.*, 2005, Halachmi, 2005) is likely to make it harder.

There are a couple of strong points to this plan. There is a need to highlight these for they are not many but could prove rather useful when an emergency happens and for other plan designers.

The first is the emergency assessment protocol. This is essentially an information collection tool that is quite simple and robust which makes it usable by the local community. This is crucial for it is the local community that is "in the front line" and speedy, clear information is what is needed from them in order to form a reliable picture of the situation. One big downside of this assessment tool is that it makes no mention of how the people making the assessment should survey a cross-section of the affected population (Perry and Lindell, 2007). This is important because different areas in the same region can be affected in various degrees and because even if the population was exposed evenly there might be subpopulations that are more affected. Even with this weakness the simplicity of this tool makes it one of the few parts of the plan that could be useful for all the administrative units.

The second is concerned with what the plan calls "auxiliary forces". These are defined as specialized volunteer units. The plan makes no reference as to who will organize these units, how they will be used and how they will cooperate with the other responders, but it does say who they can/should be made up of, and this is where it gets interesting. Amongst others, which can also be found in some UK plans (Radio Society or Red Cross), the plan also lists: private security companies, taxi companies, licensed utility climbers, licensed lifeguards, licensed divers, psychotherapy offices, private canine training centres and licensed stunt-man. One could see how this might not work.

There is however more to this than meets the eye. Lack of resources can lead to improvisation (Sharkansky and Zalmanovitch, 2000). In a country where emergency resources are far from abundant (Porfiriev, 2001) using the taxi companies [see General Gallieni and the Paris Taxis for an example (Reason, 2008)] or private canine training centres can be a potential source of assistance. In a rich country, this would be unthinkable and mostly useless, in other countries it might be a matter of legal liability, but in Romania improvisation and induced participation (WHO, 1999) are sometimes matters of necessity.

3. CONCLUSIONS

This paper has analysed an earthquake and/or landslide emergency plan designed by the Bacău County Emergency Committee to be a model emergency plan for other administrative units within the county. The emergency planning process as well as the function and structure of general emergency plans were briefly introduced. Limitations of the plan under discussion where highlighted. Special attention was given to the plan's model status, to why this is not something

recommended and to the context in which this plan was devised. Analysis revealed a couple of strong points. The latter of these potentially stems from the same context (lacking in resources) that generated the plan's major drawback in the first place.

The author acknowledges that analysing a plan that is an example of good practice is useful in determining what it has missing and what can be done about it. Despite this the author has deliberately chosen to analyze this plan for it reveals so much more about underlying issues than "not having stand down procedures in an otherwise very good plan" would. The recommendation is then to look further, to look at why a plan is written in a certain way. Different organisational cultures and socio-political contexts will produce different documents. This document is in a way a testimony of the inefficiency, laziness and lack of skills of the Romanian state apparatus. Fixing the document is a start but it is only scratching the surface. Deep changes in organisational culture, in the way policies are enacted and in the interaction between these two need to happen if loss and suffering are to be reduced.

REFERENCES

Alexander, D. (2002) *Principles of Emergency Planning and Management*. Terra Harpenden.

Alexander, D. (1993) *Natural Disasters*. UCL Press.

Baldassarri, D. and Grossman, G. (2011) 'Centralized sanctioning and legitimate authority promote cooperation in humans', *PNAS Early Edition*, pp. 1-5.

Bakuli, D.L. and Smith, J.M. (1996) 'Resource allocation in state-dependent emergency evacuation networks', *European Journal of Management Research*, 89(1996), pp. 543-555.

Bayraktar, A. and Kartal, M.E. (2010) 'Linear and nonlinear response of concrete slab on CFR dam during earthquake', *Soil Dynamics and Earthquake Engineering*, 30(2010), pp. 990-1003,

Bankoff, G., Frerks, G. and Hilhorst, D. (2004) *Mapping vulnerability: Disaster, Development & People*. Earthscan London.

Blagescu, M., De Las Casas, L., and Lloyd, R. (2005) Pathways to Accountability; The GAP Framework. A publication of one world trust. [Online]. Available at: http://www.oneworldtrust.org/index.php?option=com_content&view=article&id=70&Itemid=72 (Accesed: 20 January 2012).

Bacău County Council (BCC) (2010) *Bacău county risk analysis and coverage plan, Annex no. 5*. Bacău.

Coppola, D. (2007) *Introduction to international disaster management*. Elsevier.

French, P.E. (2011) 'Enhancing the Legitimacy of Local Government Pandemic Influenza Planning through Transparency and Public Engagement', *Public Administration Review*, pp. 253-264.

Georgiadou, P.S., Papazoglou, I.A., Kiranoudis, C.T., and Markatos, N.C. (2010) 'Multi-objective evolutionary emergency response optimization for major accidents', *Journal of Hazardous Materials*, 178(2010), pp. 792-803.

Halachmi, A. (2005) 'Governance and risk management: challenges and public productivity', *International Journal of Public Sector Management*, 18(4), pp. 300-317.

Hill, B. (2009) 'Diagnosing co-ordination problems in the emergency management response to disasters', *Interacting with Computers*, 22(2010), pp. 43-55.

Lindell, M.K. and Perry, R.W. (1992) *Behavioral Foundations of Community Emergency Planning*. Hemisphere Publishing Corporation,

Lindell, M.K., Prate, C., and Perry, R.W. (2007) *Introduction to Emergency Management*. Wiley.

London Emergency Services Liaison Panel (LESLP) (2007) Major Incident Procedure Manual, 7th edition, *Metropolitan Police Service*, London [Online]. Available at: http://www.leslp.gov.uk/docs/Major_incident_procedure_manual_7th_ed.pdf (Accesed: 20 January 2012),

Mitchell, R.K., Agle, B.R. and Wood, D.J. (1997) 'Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts', *Academy of Management Review.* 22(4), pp. 853-886.

Perry, R.W. and Lindell, M.K. (2007) *Emergency Planning.* Wiley.

Pidd, M., de Silva, F.N., and Eglese, R.W. (1996) 'Theory and Methodology. A simulation model for emergency evacuation', *European Journal of Operational Research*, 90(1996), pp. 413-419.

Porfiriev, B. (2001) 'Institutional and legislative issues of emergency management policy in Russia', *Journal of Hazardous Materials*, 88(2001), pp. 145-167.

Reason, J. (2008) *The Human Contribution: Unsafe Acts, Accidents and Heroic Recoveries*, Ashgate.

Rockett, J.P. (1994) 'A Constructive Critique of United Kingdom Emergency Planning', *Disaster Prevention and Management*, 3(1), pp. 47-60,

Romanian Government (2004) *Emergency ordinance no. 21/2004 from 15/04/2004*, Official Gazette, part I, no. 361 from 26/04/2004. Bucharest.

Sharkansky, I. and Zalmanovitch, Y. (2000) 'Improvisation in Public Administration and Policy Making in Israel', *Public Administration Review*, 60(4), pp. 321-329.

Twigg, J. (2004) Good Practice Review: Disaster Risk Reduction, Mitigation and Preparedness in development and Emergency Programming, Humanitarian Practice Network – Overseas Development Institute.

Walter, F. And Bruch, H. (2010) 'Structural Impacts on the Occurrence and Effectiveness of Transformational Leadership: An Empirical Study at the Organizational Level of Analysis', *The Leadership Quarterly*, 5(21), pp. 765-782

Wisner, B., Blaikie, P., Cannon, T. and Davis, I. (2004) *At Risk: Natural Hazards, People's Vulnerability and Disasters*, 2nd edition, Routledge London.

UK Cabinet Office (2011), Chapter 5 (Emergency Planning). Revision to Emergency Preparedness.

World Health Organisation (1999), Community Emergency Preparedness: A Manual for Managers and Policy-Makers, WHO.

GeoPatterns, Vol. III, Issue 1, April 2017, pp. 31-34

9/11, Elitism or Post-Modernism

Radu Ionescu
University of Bucharest, Romania
radu.ionescu@geo.unibuc.ro

Abstract. This paper will evaluate the way the events of 9/11 were interpreted. The evaluation will use two perspectives: Elitism and Post-modernism. The paper is structured as follows. After a short description of the events the concept of elitism is introduced. After that the focus moves on what disaster problems were identified after 9/11 from an elitist perspective, what policies this generated and what was the outcome of these policies. This same structure is kept in place in the second part of the paper where a similar evaluation happens, this time using post-modernism as a lens. The paper concludes that the two perspectives are complementary and proposes a solution grounded in cognitive psychology to what it sees as an issue of there being too many benefits associated with the creation of certain metanarratives.

Keywords: *Integrated Emergency Management, disaster narratives, elitism, post-modernism, disaster policy planning*

1. INTRODUCTION

The case – 9/11

At 8:14 a.m. on September 9, 2001, USA, five men hijacked flight American 11 shortly after its departure from Boston's Logan International Airport. This was the start of what would later be known as 9/11, a series of four coordinated suicide attacks in which the terrorists used planes as missiles (US Congress, 2004).

2. ONE PERSPECTIVE – ELITISM

Early in the 20th century Vilfredo Federico Damaso Pareto, made an observation that twenty percent of the population owned eighty percent of the property in Italy. The term 80-20 is not meant to be taken as a fixed rule but as an illustration of a power law relationship between two quantities. In other words, if the frequency of an event (in this case having property) varies as a power of some attribute of the event (*e.g.* the size of the event which in this case means how much property), then the frequency follows a power law (Kaplow and Shavell, 2001; Wilson, 1972; Sen, 1970).

Shortly after Pareto, another Italian, Corrado Gini, developed a measure of statistical dispersion which has become commonly used to measure the inequality of income and wealth. It is called the Gini coefficient and ranges from 0 (everyone in the sample has the same income or wealth) to 1 (one person in the sample has everything while the rest have nothing). These are absolute values with real-life samples (*i.e.* the population of a country) offering coefficients somewhere in between (Lambert and Aronson, 1993).

By looking at the ideas (and the data supporting them) of the two Italians one could claim that there is a small elite of people that holds the power. For Rothkopf (2008) this global power elite is what constitutes a "superclass". This superclass differs in size from country to country (the higher the Gini the larger it is). The US for example has a Gini of 45% (or 0.45), close to China's 41.5% yet far from Germany's 27% or Sweden's 23%. Other countries in the 45% region include Uganda, Mozambique and, quite ironically the author would add, Iran.

3. THE PROBLEM – THE STATE

The income (and the power that comes with it) disparity in the democratic US is similar to the one in China or Iran. What were the problems that the ruling elite of this apparent democracy identified after a terrorist attack on its soil?

The declared problems were the enemy and homeland security. On September 14, 2001, the State Department detailed public U.S stance: eliminate terrorism as a threat, punish those responsible for 9/11, hold actors responsible for providing sanctuary, and "avoid malice toward any people, religion, or culture" (US Congress, 2004). Wallace & Suedfeld (1988 in Buck, 2003) looked at a variety of leaders in a range of situations and showed that the ability to maintain complexity under stress is closely linked with the ability to resolve a crisis without resorting to war. The US had taken the role of "global policeman" (Jermalavicius, 2001). Even so there is nothing quintessentially elitist about this. One could argue that one country chose to show its military superiority over another thereby attracting the label of elitist but countries are not elitist, the people that run them are. People make decisions that impact other people. The more power the more important the decision the bigger the impact. The actual perceived problem was the state; the state of Afghanistan, the state of Iraq and the state of USA. As Rumsfeld put it: "The adversary is closer to home. It's the Pentagon bureaucracy." (Klein, 2008)

4. THE POLICIES – HOLLOW THE STATE

One can become part of the elite by way of intelligence, credentials (meritocracy), knowledge, skills (technocracy) or wealth (plutocracy). This ruling elite could describe itself as left-winged (Hu Jintao or Mitterrand and protégées) or right-winged (Reagan or Bush and protégées). This is relevant because whichever belief system the elite holds, it will filter the way reality is interpreted. It is based on this interpretation of the self, the world, and the future that the policy is set (Bless et al, 2004). The belief system of the ruling elite in the US seems to be constructed around Friedman's views: remove rules and regulations that stand in the way of accumulating profits, sell state assets so that corporations can run them at a profit, and cut funding for social programs (Klein, 2008). The resulting policies: invade two countries (one of which had nothing to do with 9/11) using a privatized army and create a privately-run security state at home.

5. THE OUTCOME

When a state representative awards a contract to a company that he owns it is a conflict of interests. When Lockheed Martin makes fighters and bombs, then reconstructs what those bombs destroyed and even treats the people injured by the same weapons it is referred to as vertical integration. This situation has created a perpetual state of war or in Rothkopf's (2008) words: "the first ever military campaign against a feeling". This in turn has increased the profits of the corporations waging the war, the right-wing think-tank's that they support and the media that they own. In the meantime, the state has been turned in to a shell with business as its ghost. 100,000 excess deaths have occurred since the 2003 invasion of Iraq (Roberts, 2006). The purposes of an army are to defend its country or to attack others. Neither of these aims is altruistic. An army's equipment, training and, above all, mindset are designed for these aims (Coleman, 2011). Yet "international political agendas are cloaked in humanitarian vocabulary" (Reltien, 2001). The reason (from an elitist perspective) why so many have died and millions are suffering today is because a few very powerful people (the elite) interpreted 9/11 (the case) as an opportunity to unleash disaster capitalism (the policy) in order to absorb the state's role in disaster preparedness, response and recovery (perceived problem). The author willingly left mitigation out as this tends to bring profits down by lowering response and recovery costs. It would, in other words, beat the purpose.

6. ANOTHER PERSPECTIVE – POST-MODERNISM

The case remains the same; 9/11. This is done in order to offer a wider view and to eliminate the bias

of selecting one case over another just so it can better fit the theory that the writer agrees with.

A theory contrasting that of elitism is pluralism, but this, in turn, draws its assumptions from post-modernism (Hassan, 1986). The contrast itself is debatable because as Schattschneider (1960) put it: "The flaw in the pluralist heaven is that the heavenly chorus sings with a strong upper-class accent." So instead of looking at the case from a narrow, normative and arguably utopian perspective (*i.e.* pluralism) the author will use the wider, relativist, framework of post-modernism.

Post-modernism puts forward the idea that facts do not exist outside or separately from the processes of thinking, speaking and writing them. If this is accepted as a premise then reality is relative and the way knowledge is constructed depends on who constructs it. The narratives that are told within a certain culture add up to create an untold metanarrative that unifies the way the world is understood (Rosenau, 1992). Therefore, if the words that are used create the facts in the minds of the people listening to the narrative then the way to see what problems 9/11 supposedly revealed is to look at the discourse, the narrative, the words.

7. THE PROBLEM – IT'S A NEW WORLD

After 9/11 the narrative that was constructed in US society based on pre-existing metanarratives of US superiority was: There is an axis of evil out there that wants to hurt our liberty, democracy, capitalism (this could even be considered a return to modern metanarratives) so you are either "with us or against us". This last part later turned in to a pejorative "old Europe" when referring to Germany and France who decided not to invade Iraq (Klein, 2008). With few but potent words the story was being told. The first problem that emerged from this discourse was that things were not the same, a semantic had been created and embedded: post 9/11. In this totally new world US society and citizens were in danger and outside there were forces of evil that previously did not exist.

"We're an empire now, and when we act, we create our own reality. And while you're studying that reality – judiciously, as you will – we'll act again, creating other new realities, which you can study too, and that's how things will sort out. We're history's actors… and you, all of you, will be left to just study what we do."

In an age when all the grand ideas have lost credibility, fear of a phantom enemy is all the politicians have left to maintain their power." (Curtis, 2004)

8. THE POLICY – ADAPTATION

Using the "post 9/11" semantic as an overarching argument, policies such as the Patriot Act and the invasions of Afghanistan and Iraq were enacted. In this narrative, the US's equivalent of the Russian Motherland, the Homeland, is in great danger and needs information about its citizens to better protect itself. The Patriot Act follows this logic and allows for invasions of privacy and data mining without warrant. The companies doing the surveillance on behalf of some state entity are usually politically connected (Klein, 2008). Narratives are created in cultures and create the symbols on which cultures feed. (Rosenau, 1992) It should come as no surprise then, that in a fundamentally capitalist culture such as the one in US the new narrative only puts profit seeking organizations in an even better position than before.

9. THE OUTCOME

The outcome that is of interest from a post-modern perspective is the metanarrative, the story that does not need to be told in order to be known and accepted as reality. The societies that are first captured by the new metanarative are unsurprisingly, considering the importance of language, the Anglophone ones. If one were to look at reality via the predominant story found in China, Iran or France then one might see another world.

Language cannot however be the only reason why the story does not go much further than the Western, English speaking world. Post-modernism is interested in who tells the story, how much power do they have and why are they telling it the way they are? If one looks at the companies profiting from the Patriot Act and the invasion of Iraq then one notices that the people that have interests in these companies are the same people telling the

story. Companies such as Halliburton or Lockheed Martin press for the narrative that they support this matter, in the US. Companies such as BP do the same in the UK. It would make no financial sense for Halliburton to push for its story in say Portugal because the Portuguese do not get to elect US government officials that could potentially ask for warrants to be issued every single time before covert data collection, inter alia.

10. CONCLUSION

Key here are power law relationships because although elitism is about a powerful few ruling the majority (oversimplifying) and post-modernism is about the way reality is constructed trough stories (again oversimplifying) it is probably evident by now that the two can be complementary. If one takes Pareto's power law relationship mentioned in the beginning as a constant (*i.e.* the more power the fewer the powerful) then the only thing that can change is the elite's behaviour. The incidence of an individual's operational behaviour correlates with the positive expected outcomes generally associated with that behaviour. So as long as the elite has a positive expectancy (money, power, anything that is interpreted as positive) it will continue to create the narrative (operational behaviour). It is only by removing the expectancy that the non-elite will have a chance to create its own story. Narratives are created in cultures and create the symbols on which cultures feed. (Rosenau, 1992) It should come as no surprise then, that in a fundamentally capitalist culture such as the one in US the new

REFERENCES

Bless, H., Fiedler, K. and Strack, F. (2004) *Social Cognition. How Individuals Construct Reality*. Psychology Press.

Coleman, S. (2011) The Moral Dangers of Non Lethal Weapons, Lecture at TEDxCanberra, [Online]. Available at: http://www.ted.com/talks/lang/en/stephen_coleman_the_moral_dangers_of_non_lethal_weapons.html (Accessed 23 March 2012).

Curtis, A. (2004). *The power of nightmares: The rise of the politics of fear* (Vol. 2, No. 3). UK: BBC.

Hassan, I. (1986) 'Pluralism in Postmodern Perspective', *Critical Inquiry*, 12(3), pp. 503-520.

Jermalavicius, T. (2011) 'The World After September 11th: Change and Continuity', *Baltic Defence Review*, 6. pp 76-95.

Kaplow, L. and Shavell, S. (2001) 'Any Non-welfarist Method of Policy Assessment Violates the Pareto Principle', *Journal of Political Economy*, 109(2), pp. 281-286.

Kerr, O.S. (2003) 'Internet Surveillance After the USA Patriot Act: The Big'.

Klein, N. (2008) *The Shock Doctrine: The Rise of Disaster Capitalism*. Penguin.

Lambert, P.J. and Aronson, J.R. (1993) 'Inequality Decomposition Analysis and the Gini Coefficient Revisited', *The Economic Journal*, 103(420), pp. 1221-1227

Reltien, C. (2001) Humanitarian Action in Notrh Koreea: Osatrich Politics, in *The Geopolitics of Hunger 2000-2001 Hunger and Power*, Action Against Hunger, Lynne Rienner Publishers

Roberts, L., Doocy, S., Lafta, R., and Burnham, G. (2006) 'Mortality after the 2003 invasion of Iraq: a cross-sectional cluster sample survey', *The Lancet*, 368(9545), pp. 1421-1428.

Rosenau, P.M. (1992) *Post-Modernism and the Social Sciences: Insights, Inroads and Intrusions*, Princeton University Press.

Rothkopf, D. (2009) *Superclass: The Global Power Elite and the World They Are Making*. Penguin.

Sampson, A. (2005) *Who Runs This Place?: The Anatomy of Britain in the 21st Century*. Updated edition. John Murray.

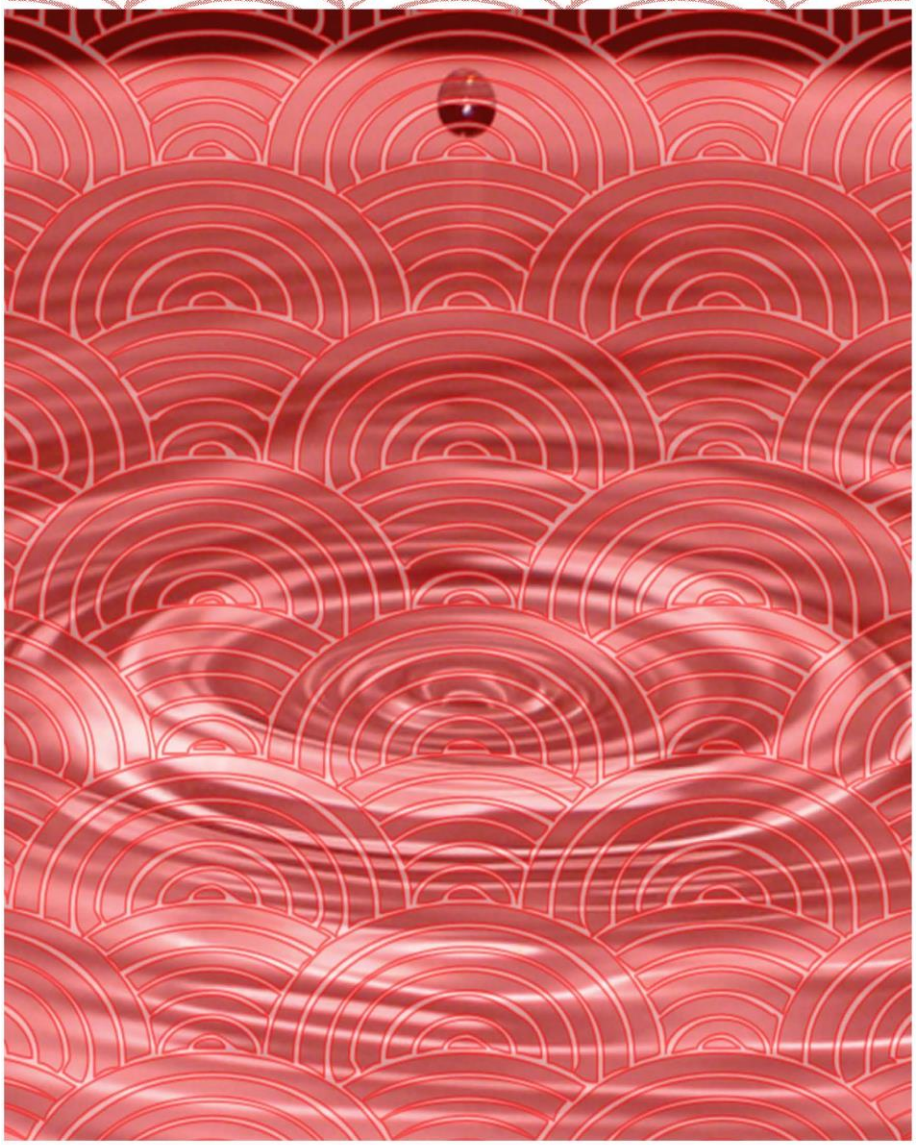
Schattschneider, E.E. (1960) *The Semi-Sovereign People*. New York: Holt, Rinehart and Winston.

Sen, A. (1970) 'The Impossibility of a Paretian Liberal', *Journal of Political Economy*, 78(1), pp. 152-157.

Wallace M & Suedfeld P (1988) Leadership Performance in Crisis: The Longevity-Complexity Link, International Studies Quarterly, 32, pp. 439-451, in Buck, G. (2003) 'The role of psychological factors in the management of crisis situations', unpublished, University of Westminster.

Wilson, R. (1972) 'Social choice theory without the Pareto Principle', *Journal of Economic Theory*, 5(3), pp. 478-486.

Volume 3, Issue 1, April 2017



GeoPatterns

"Science is the millennial endeavor to identify the underlying patterns that form our world and explains the interconnectedness of the natural and social systems."