

INTERDISCIPLINARY DESCRIPTION OF COMPLEX SYSTEMS

Scientific Journal

<i>S. Caschili and F.R. Medda</i>	1	A Review of the Maritime Container Shipping Industry as a Complex Adaptive System
<i>A. Jugović</i>	16	Public Administration: Main Factor in Successful Management of Coastal Area Development in Republic of Croatia
<i>M. Neumann</i>	28	Modelling the Dynamics of Securizating National Identities
<i>M. Marković, I. Stojanović and B. Runje</i>	50	Propagation of Nonlinear Phenomena in a Measurement Sequence

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TABLE OF CONTENTS

<i>Urban Kordeš, Olga Markič and Josip Stepanić</i>	ii	Announcement
<i>Josip Stepanić</i>	iii	INDECS Award

REVIEW

<i>Simone Caschili and Francesca Romana Medda</i>	1	A Review of the Maritime Container Shipping Industry as a Complex Adaptive System
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REGULAR ARTICLES

<i>Alen Jugović</i>	16	Public Administration: Main Factor in Successful Management of Coastal Area Development in Republic of Croatia
<i>Martin Neumann</i>	28	Modelling the Dynamics of Securizating National Identities
<i>Marija Marković, Ivan Stojanović and Biserka Runje</i>	50	Propagation of Nonlinear Phenomena in a Measurement Sequence

COGNITIVE SCIENCES AS AN INTERDISCIPLINARY ENDEAVOUR

Integration of third person and first person approaches

INDECS *CogSci* – Thematic issue of journal

ANNOUNCEMENT

Dear readers,

we are happy to announce that from this volume on, INDECS will be one issue per year richer!

Of all the areas where interdisciplinary thinking, research and collaboration are most vitally needed, cognitive science is surely one of the foremost. Is it cognitive sciences or cognitive science? The question remains open, and depends on success of interdisciplinary cooperation. We believe that only synergy between different disciplinary perspectives can provide a full understanding of cognition-related phenomena.

That is why we decided to dedicate that new, third issue per volume, to this exciting young area of interdisciplinary research.

We are cordially inviting theoretical and experimental papers that tackle cognitive science related issues, especially those that tackle problems from the interdisciplinary point of view. First *CogSci* issue, INDECS 10(3), will be dedicated to the open questions concerning the integration of third and first person approaches. We are inviting papers tackling the explanatory gap from philosophical and methodological perspectives as well examples of research joining 1st and 3rd person perspective.

Manuscripts should be prepared in English and submitted not later than 1st September 2012. The consideration of manuscripts will follow the regular review process of the INDECS journal.

Accepted articles will be published in the issue of INDECS 10(3), October 2012.

Cordially,

CogSci-issue editors
Prof. Urban Kordeš
Prof. Olga Markič

Editor-in-chief
Prof. Josip Stepanić

INDECS AWARD

Dear readers,

INDECS award for the best article published in the year 2011 – INDECSA 2011, goes to Jovana Zoroja, for her article *Internet, E-Commerce and E-Government: Measuring the Gap between European Developed and Post-Communist Countries*, published in INDECS 9(2).

This decision is a consequence of the procedure for choosing the best article published in one year, i.e. in one volume of journal INDECS, as described in document INDECS-DD-005-3.

Let me congratulate Ms. Zoroja in the name of the Advisory and Editorial Board of the journal INDECS and in my personal name.

Let me thank, in the name of the Advisory and Editorial Board and in my personal name, all the authors and co-authors of articles published in the journal INDECS in year 2011, for high quality of their articles.

Zagreb, 26 February 2012

Editor-in-chief
Prof. Josip Stepanić



A REVIEW OF THE MARITIME CONTAINER SHIPPING INDUSTRY AS A COMPLEX ADAPTIVE SYSTEM*

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Review

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ABSTRACT

If we consider the worldwide maritime shipping industry as a system, we observe that a large number of independent rational agents such as port authorities, shipping service providers, shipping companies, and commodity producers play a role in achieving predominant positions and in increasing market share. The maritime shipping industry can, from this perspective, be defined as a Complex System composed of relatively independent parts that constantly search, learn and adapt to their environment, while their mutual interactions shape obscure but recognizable patterns. In this work we examine the maritime shipping industry through the Complex Adaptive System (CAS). Although CAS has been applied widely to the study of biological and social systems, its application in maritime shipping is scant. Therefore, our objective in the present paper is to provide a literature review that examines the international maritime industry through the lens of CAS. We also present some of the goals that may be achieved by applying the CAS approach to the container shipping industry in particular. The construction of a tenable ontological framework will give scholars a comprehensive view of the maritime industry and allow them to test the stability and efficiency of the framework to endogenous and exogenous shocks.

KEY WORDS

international trade, maritime container shipping industry, complex adaptive systems

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INTRODUCTION

The significant expansion of global trade, technological advancements and continuous changes in the world's geopolitical scenarios, has typified the development of the contemporary maritime shipping industry. In 1980 the intercontinental shipping freight volume comprised approximately 23 % of the total world volume. At present, many authors estimate that this shipping freight volume ranges between 77 % and 90 % of the transport demand [1-4]. The total number of Twenty-foot Equivalent Units (TEUs) carried worldwide has increased¹ from 28,7 million in 1990 to 148,9 million in 2008; and similarly, average vessel capacity has grown from 1900 TEUs in 1996 to 2400 TEUs in 2006. While in 1996 vessels larger than 5000 TEU constituted only 1 % of the world's fleet, in 2001 vessel capacity had increased to 12,7 % and to 30 % by 2006 [5]. In this context the containerization revolution and technical improvements relative to the size, speed and design of vessels, as well as automation in port operations, have been pivotal to the success of maritime shipping activity [2, 6]. For instance, maritime transport has one of the lowest transport costs per TEU-mile over long distances for large quantities of goods [1]. But as Kaluza et al. [7] observe, another reason must account for maritime shipping success, which they reckon is the growth of transpacific trade that has been fuelled by the globalization process. The container shipping industry has arisen as the leading transportation means for inter-oceanic shipping of manufactured goods, and for this reason we focus our critical overview on the container industry.

In the rapid development of the global maritime system we can observe the presence of various independent rational agents (shipping companies, commodity producers, ports and port authorities, terminal operators, and freight brokers). Mutual interactions among large numbers of independent rational agents determine the growth, and thus the success, of this industrial sector. From this standpoint, our perspective in the present paper is to examine the container shipping industry in particular as a Complex System of relatively independent parts that constantly search, learn and adapt to their environment, while their mutual interactions shape obscure patterns with recognizable regularities that evolve continuously. The science of Complex Adaptive System (CAS) provides a useful framework for the analysis of shipping systems [8-16]; as noted in the literature, CAS refers to a field of study in which its strategic analysis is based on reductionism (bottom-up investigation), and complex adaptive systems are generally composed of a set of rational, self-learning, independent, and interacting agents whose mutual interrelations generate non-linear dynamics and emergent phenomena.

Since the 1980s rational agents in the maritime industry have continuously evolved within their organizations in response to external stimuli such as market competition. In logistics and management structures in particular, new forms of inter-firm organizations have emerged in the shipping industry. Rodrigue et al. [2] explain succinctly how this change has occurred: *[...] many of the largest shipping lines have come together by forming strategic alliances with erstwhile competitors. They offer joint services by pooling vessels on the main commercial routes. In this way they are each able to commit fewer ships to a particular service route, and deploy the extra ships on other routes that are maintained outside the alliance. [...] The 20 largest carriers controlled 26 % of the world slot capacity in 1980, 42 % in 1992 and about 58 % in 2003. Those carriers have the responsibility to establish and maintain profitable routes in a competitive environment.*

The development of the shipping industry has gone hand-in-hand with changes in port organization. According to a recent study for the European Parliament [17], ports have undergone major transformations in their organizational structures, i.e., they have evolved from the containerization process to what is known as the 'terminalisation era', where ports carry out multi-functional operations through the development of highly specialized terminals.

As the maritime shipping system has evolved, so has the role of port authorities also transformed. Their main duties now involve the optimization of process and infrastructures, logistics performance, the promotion of intermodal transport systems, and increased relations with their hinterlands.

If we assume that international trade can be explained through bottom-up phenomena arising from the interaction among individual agents, it may be possible to understand how new patterns emerge in the global shipping system. In light of the above observations, our objective in this study is to conduct a review with the aim to present a framework for the application of CAS theory to the maritime container shipping industry.

The analysis is organized as follows. In the subsequent sections we review the main features of Complex Adaptive Systems, provide a detailed discussion on CAS methodology, and discuss the opportunity for scholars and practitioners to apply CAS modelling to the maritime shipping industry. We conclude with a research agenda for future studies.

COMPLEXITY SCIENCE AND COMPLEX ADAPTIVE SYSTEMS: KEY CHARACTERISTICS

Various scholars [14, 18, 19] define a Complex System by observing particular features within a given system. These features are: emergent, self-organizing/adaptive, non-linear interactions in evolution. For instance, emergent phenomena are classifiable through the demonstration of their unpredictable behaviours when we account for each part of the system. This concept is exemplified by the famous statement “the whole is greater than the sum of the parts” [19, 20]. Recessions and financial growth are, for example, emergent phenomena of national economies.

The class of CAS is one of the conceptualizations belonging to the framework of Complex Systems. According to Anderson [21], scholars have developed different approaches and theories in their need to better understand Complexity: Mathematical (Turing and Von Neuman), Information Theory, Ergodic theory, Artificial Entities (cellular automata), Large Random Physical systems, Self-Organized Critical systems, Artificial Intelligence, and Wetware. Anderson’s classification places CAS into the Artificial Intelligence approach. What most characterizes this distinctive class of Complex System are the processes of adaptation and evolution. A system is adaptive when its agents “*change their actions as a result of events occurring in the process of interaction*” [22]. Evolution is created through the local interactions among agents. In this sense, adaptation can be seen as a passive action in which the agents absorb information from the surrounding environment (or from previous experience); whereas evolution is generated by the mutual actions among agents. Fig. 1 shows how adaptation and evolution are embedded in different classes of systems.

On the basis of the previous definitions, complex systems must be both adaptive and evolving systems. Unintelligent evolving systems develop through interaction processes but they do not adapt. For example, a crystal is generated by mutual interactions among atoms or molecules that have no intelligence of the process in which they are involved. Furthermore, complicated systems are made by numerous interacting elements that do not adapt or evolve in the system. Complicated artefacts such as a car engine belong to this class. The lower right-hand quadrant in Fig. 1 is empty, as no adaptive system shows static structures. Adaptation and evolution play off each other and by this we mean that the adaptation process includes the concept of evolution but not the reverse.

According to Wallis [23], there is no consensus on CAS unified theory, but Holland [12] nevertheless calls for a unified theory of CAS. Although many authors have developed comprehensive frameworks [8-11, 15], we focus in this work on Holland’s [13] approach to

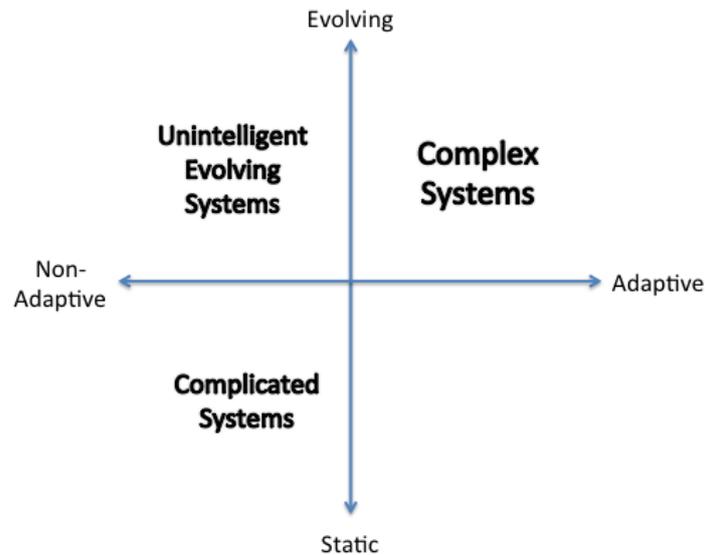


Figure 1. Graph of systems that evolve and adapt.

modelling CAS, which is used widely in much of CAS literature, especially in economic applications. In one of the most robust works towards a unified theory of CAS, Holland [13] suggests four properties and three mechanisms that a CAS must possess. Although Wallis [23] argues that Holland's seven attributes for CAS are not definitive, he nonetheless remarks that "other candidate features can be derived from appropriate combinations of these seven." We present below a summary of the seven basic features and group them into properties and mechanisms.

FOUR PROPERTIES

Aggregation

The concept of aggregation is twofold. The first facet involves how the modeller decides to represent a system. Decisions on which features to leave in and which to ignore are of paramount importance. In this sense elements are aggregated in 'reusable' categories whose combinations help to describe scenes, or to be more precise, "*novel scenes can be decomposed into familiar categories.*" The second facet can be ascribed to CAS aggregation properties which relate to the emergence of global behaviors caused by local interactions; in this case agents perform actions similar to other agents rather than adopt independent configurations. Furthermore, aggregation often yields co-operation, in that the same action of a number of agents produces results that cannot be attained by a single agent. We can explain this concept using the analogy of the ant nest. An ant survives and adapts to different conditions when its actions are coordinated with ant group (the nest), but the ant will die if it works by itself. Likewise in a CAS, a new action will survive and induce global effects if it is adopted by a large number of agents.

Non-linearity

Agents interact in a non-linear way so that the global behavior of the system is greater than the sum of its parts.

Flows

Agents interact with one another to create networks that vary over time. The recursive interactions create a *multiplier effect* (interactions between nodes generate outcomes that flow from node to node, creating a chain of changes) and a *recycling effect* (in networks cycles

improve local performance and create striking global outcomes).

Diversity

Agent persistence is highly connected to the context provided by other agents so as to define “the niche where the agent outlives.” The loss of an agent generates an adaptation in the system with the creation of another agent (similar to the previous) that will occupy the same niche and provide most of the missing interactions. This process creates diversity in the sense that the new specie is similar to the previous one but introduces a new combination of features into the system. The intrinsic nature of a CAS allows the system to carry out progressive adaptations and further interactions, and to create new niches (the outcome of diversity).

THREE MECHANISMS

Tagging

Agents use the tagging mechanism in the aggregation process in order to differentiate among other agents with particular properties; this facilitates a selective interaction among the agents.

Internal models

Internal models are the basic models of a CAS. Each agent has an internal model that filters inputs into patterns and differentiates learning from experience. The internal model changes through agent interactions and the changes bias future actions (agents adapt). Internal models are unique to each CAS and are a basic schema for each system. The internal model takes input and filters it into known patterns. After an occurrence first appears, the agent should be able to anticipate the outcome of the same input if it occurs again. Tacit internal models only tell the system what to do at a current point. Overt internal models are used to explore alternatives or anticipate the future.

Building blocks

With regard to the human ability to recognize and categorize scenes, CAS uses the building block mechanism to generate internal models. The building block mechanism decomposes a situation by evoking basic rules learnt from all possible situations it has already encountered.

An application using all of the seven features allows analysts to define environments where adaptive agents interact and evolve. In the next section we therefore examine two specific studies dedicated to maritime container shipping (The Global Cargo Shipping Network: GCSN) through the lens of Complex Adaptive Systems.

THE GLOBAL MARITIME NETWORK

Only a few studies in the maritime literature focus on the global maritime network, of which the acronym GCSN stands for Global Cargo Ship Network. Scholars have mainly addressed sub-networks of the GCSN, such as Ducruet et al. [24], who have analysed the Asian trade shipping network, McCalla et al. [25] the Caribbean sub-network, Cistic et al. [26] the Mediterranean liner transport system, and Helmick [27] the North Atlantic liner port network. However, two recent articles [5, 7] examine the main characteristics of the complete global network, giving us a view of the macroscopic properties of the global maritime network. In line with our objective here, the aim of both studies is to characterize the global movements of cargo in order to define quantitative analyses on existing structural relations in the rapidly expanding global shipping trade network. But the one main drawback of their studies is their inability to forecast future trends or track changes in the networks.

In Table 1 we highlight the similarities and differences between our two selected studies on the GCSN. Kaluza et al. [7] use the Lloyd's Register Fairplay for year 2007, while Ducruet and Notteboom [5] utilize the dataset from Lloyd's Marine Intelligence Unit for years 1996 (post-Panamax vessels period) and 2006 (introduction of 10 000+ TEU vessels).

By applying different approaches to the network analysis, both studies reach different conclusions in some cases. Ducruet and Notteboom build two different network structures: the first (Graph of Direct Links – GDL) only takes into account the direct links generated by ships mooring at subsequent ports, and the second (Graph of All Linkages – GAL) includes the direct links between ports which are called at by at least one ship. Kaluza et al. [7] differentiate among movements according to type of ship and subsequently construct four networks: all available links, sub-network of container ship, bulk dry carriers, and oil tankers. Despite clear differences between the approaches adopted in the two studies, in order to compare them, we consider the complete network of ship movements from Kaluza et al. [7], and the GAL network of Ducruet and Notteboom [5].

All the networks are dense (average ratio between number of edges and nodes is 37,2). Some network measures indicate a tendency for the GCSN to belong to the class of small world networks², given the high values of the Clustering Coefficient³. Small world networks are a special class of networks characterized by high connectivity between nodes (or in other words

Table 1. Overview of the main features of the GCSN as proposed Kaluza et al. [7] and Ducruet and Notteboom [5].

	Kaluza et al. network (Year 2007) [7]	GAL (Year 1996) [5]	GAL (Year 2006) [5]
Main features	Asymmetric (59% connections in one direction); structural robustness (densely connected)	Weighted indirect network; small network	Weighted indirect network; small network
# Vessels	Total 11 226; Container ships 3100; Bulk dry carriers 5498; Oil tankers 2628	Container ship 1759	Container ship 3973
Weights	Sum of cargo capacity between port i and port j	Not specified	Not specified
No. of nodes	951	910	1205
No. of links	36 351	28 510	51 057
Min. shortest path	2,5	2.23	2,21
Clustering coeff.	0,49	0.74	0,73
Average degree; Max. degree	76,5; -	64,1; 437	87,5; 610
$P(k)$	Right skewed but not power law	-0,62	-0,65
$P(w)$	Power law ($1,71 \pm 0,14$)	-	-
Betweenness Centrality	Strong correlation between degree and centrality with some exceptions	Suez and Panama Canals have high centrality (vulnerability of the GCSN)	

words, low remoteness among the nodes). In the maritime setting this property has a significant value; the connections among ports can in fact create clusters of small specialized ports that gravitate around a large port (hub). The large port uses small sub-peripheral ports to sub-contract operations; by so doing, all the ports (hub and peripheral) reach their goals and increase the economic entropy of the system [28].

The expression of the clustering effect, Degree distribution⁴ $P(k)$ shows that “most ports have few connections, but there are some ports linked to hundreds of other ports” [7]. However, when the authors examine the degree distribution in detail, they find that the GCSN does not belong to the class of scale free networks. Both studies show low power law exponents or right skewed degree distributions, but if the authors had shown a ranking of the ports over time, the degree distribution analysis would have had a higher significance. This would have informed them if there had ever been a turnover of dominant hubs, which in turn had led to the detection of competitive markets in maritime shipping. Opposite results would have depicted a constrained market.

Kaluza et al. [7] also studied the GCSN as a weighted network where the distribution of weights and Strength⁵ displays a power law regime with exponents higher than 1. This finding is in line with the existence of a few routes with high intensity traffic and a few ports that can handle large cargo traffic. The detection of power law regimes is often associated with inequality (i.e. distribution of income and wealth) or vulnerability in economic systems [28, 29]. The correlation between Strength and Degree of each node also fits a power law, implying that the amount of goods handled by each port grows faster than the number of connections with other ports. Hub ports also do not have a high number of connections with other ports, but the connected routes are used by a proportionally higher number of vessels.

Ducruet and Notteboom’s work [5] does not provide results of the weighted network analysis over years 1996 and 2006. An analysis of this type would have allowed us to discuss relevant facts about the dynamics of flows in the main interoceanic routes as well as give constructive criticism on the impacts of the introduction of large loading vessels (post-Panamax era) on specific routes.

It is possible to inspect the centrality of ports in a network (i.e. the importance of a node) in addition to other topological measures. In the case of GCSN, both studies use measures of the Betweenness Centrality⁶. Kaluza et al. [7] emphasize a high correlation between Degree k and the Betweenness Centrality, thus validating the observation that hub ports are also central points of the network. Ducruet and Notteboom detect interesting anomalies in the centrality of certain ports. Large North American and Japanese ports are not in the top ranking positions in terms of network centrality despite their traffic volume. The most central ports in the network are the Suez and Panama Canals (as gateway passages), Shanghai (due to the large number of ships “visiting” the port) and ports like Antwerp (due to its high number of connections.)

Although maritime shipping has been experiencing a tremendous period of expansion in the last decade, the underlying network has a robust topological structure which has not changed in recent years. Kaluza et al. [7] observe the differences “in the movement patterns of different ship types.” For example, container ships show regular movements between ports, which can be explained by the type of the service they provide; whereas dry carriers and oil tankers tend to move in a less regular manner because they change their routes according to the demand of goods they carry.

Finally, maritime shipping appears to have gained a stronger regional dimension over the years. In 1996 there was a stronger relation between European and Asian basins while in 2006 these connections appear to have weakened. Ducruet and Notteboom [5] explain this as

a dual phenomenon. Each basin has reinforced the internal connectivity while the Asian basin is witnessing a strong increase in the volume of goods shipped. The direct consequence is that Asian countries have been splitting their links with European countries. Physical proximity also helps to explain the increase of regional basins as well as the establishment of international commercial agreements such as the NAFTA and MERCOSUR between North and South America [5].

DISCUSSION OF MARITIME SHIPPING USING CAS FRAMEWORK

In the previous section we have discussed two recent studies that consider a static analysis of the global cargo-shipping network. From the previous studies [5, 7] we can conclude that GCSN is a small world network with some power law regimes when it is examined as a weighted network. This evidence indicates that the underlying structure is not dominated by random rules, and that the complex organization emerges from the interaction of lower-level entities.

Self-organization in shipping is identified as a bottom-up process arising from the simultaneous local *non-linear* interactions among agents (i.e. vessels, ports, shipping alliances or nations according to the scale of analysis). This allows us not only to notice that in GCSN our aim is to understand why certain ports are able to play a leading role, but also to estimate the shipping trade trends. Using another example from nature, we know that flocking birds generate patterns based on local information. Each bird learns from other birds and adapts its speed and direction accordingly in order to reach the next spot. Shipping companies compete in the market in the same way in accordance with their own interests. The introduction of innovation makes a company more competitive, new rules are resultantly set in the market which compel other companies to co-evolve in order to be profitable. This adaptive process has been witnessed in maritime shipping at different stages with the introduction of new technologies such as improvements in the fleets (launch of post-Panamax ships) or in port management processes (automation of loading and unloading services).

Based on the work in [5, 7], our next step is to identify a set of CAS features related to shipping systems. We select ten characteristics extracted from a number of works that have proposed applications of CAS modelling [23]. In Table 2 we relate each characteristic to Holland's classification described in Section 2 and to a possible CAS modelling application for shipping systems. In the remainder of this section we discuss how our ten characteristics are constructive elements for a CAS shipping system.

As discussed previously, international shipping involves a large collection of entities (Table 2 – Feature: *Many interacting/interrelated agents*) whose interactions create non-linear trends (Table 2 – Feature: *Non-linear/Unpredictable*). Given these two analytical perspectives, we can examine the local interactions among ships and show how they are assigned to different ports according to price and demand for the goods they carry (Table 2 – Feature: *Goal seeking*). Conversely, according to the modelling proposed in [5, 7], seaports may be considered as agents of a CAS. In this case the most interesting questions revolve around understanding how a shipping system evolves in relation to external shocks (Table 2 – Feature: *Co-evolutionary*). For instance, in cases of sudden undesired events such as terrorist attacks or extreme natural phenomena (earthquakes and hurricanes), the maritime shipping network would *co-evolve* in order to maintain the same level of provided service if a big seaport hub were to disappear or be severely damaged.

If we return to our analogy of natural systems, we can raise some fundamental questions: how would an ecosystem evolve if a species were to disappear? Would an extinct species be replaced by new species and would other species be able to survive without it? Similarly, we

Table 2. Comparison of Complex Adaptive System (CAS) features with shipping.

Feature	Description	References	Holland basics	Maritime shipping system
Self-organization	Formation of regularities in patterns of interactions of agents that pursue their own advantage through simple rules.	34-42	Tagging, non-linearity	The GCSN is a small world network with some power law regimes when inspected as a weighted network. This evidence shows that the underlying structure is not dominated by random rules, and that complex organization emerges from the interaction of lower-level entities.
Many interacting, interrelated agents	Large number of locally-interconnected and interacting rational agents that continually pursue their own advantage.	34-38, 43-52,	Flows, tagging	This concept is already embodied in the definition of the maritime shipping system. If we only consider the fleet system and the connections established between ports, we observe approx. 10 000 vessels, 1000 ports and 50 000 connections (see Table 1 for details).
Distributed control	CAS's outcomes emerge from a self-organization process rather than being designed and controlled by a centralized body or externally	12, 14, 43, 51, 52	Flows, internal model	Although there are international trade agreements that unavoidably influence maritime shipping, these pacts can be seen as external forces that increase system entropy and prompt more economic relationships.
Non-linear unpredictable	Interactions are non-linear and thus intractable from a mathematical point of view.	14, 22, 28, 36-38, 40, 43, 45-49, 46, 53	Non-linearity	The GCSN shows power law fit distributions and not random topological structures, thereby signalling the emergence of non-linear interactions between a system's agents.
Co-evolutionary	The environment is influenced by the activities of each agent.	43, 45, 46, 36, 39, 54, 41, 52	Diversity and tagging	i.e. introduction of post Panamax and 10 000+ TEU ships change carriers routing networks and tariffs as well as the volume of transshipped cargo handled at main ports.
Emergence	Interplay between agents shapes an obscure but recognizable regularity (e.g. the brain has consciousness but single neurons have not)	52, 12, 14, 53	Aggregation, flows, internal model	i.e. emergence of regional clusters of ports.
Goal seeking	Agents try to adapt in order to fulfil	43, 34, 44, 50,	Flows, internal	Dry carriers and oil tankers tend to move in an irregular manner

	goals.	54, 41	model	because they change routes according to demand for the goods they carry.
Nested systems	Each agent can be considered as a system. Each system is part of something bigger, thus each system can be a sub-system of a bigger system.	55, 5]	Diversity and internal model	Port alliances at national or international level are nested clusters of ports. The same port may belong to a cluster of ports at national level and to a cluster of ports at inter-national level, but this category may not necessarily include all the ports to which it belongs within the national cluster.

can apply such questions to the case of maritime shipping in order to forecast future configurations and prevent global breakdowns in national and international markets (Table 2 – Feature: *Self-organization*).

The maritime shipping industry is comprised by several relevant sectors such as international maritime transport, maritime auxiliary services and port services; they have a fairly long history of co-operation since the 1990s with the formation of consortia and alliances. Each co-operation is regulated by a wide range of “*national and international regulations responding to specific issues that have arisen as the international trading system has evolved*” [33]. The outcomes of these collaborations influence the setting of freight rates and shipping company tariffs. In light of the previous remarks, co-operation among agents (shipping companies, port authorities, and so on) should be included in the modelling (Table 2 – Features: *Distributed control* and *Nested Systems*).

In particular, international economic alliances in trade agreements are influential in the definition of trade flows and development. For instance, China’s admittance into the WTO has affected the bilateral negotiations between WTO countries and China itself as well as among former members (Table 2 – Feature: *Co-evolutionary* and *Self-organization*), but other examples of international trade agreements show similar impacts on international trade processes (NAFTA among North American countries, MERCOSUR in South America, ASEAN-AFTA among five Asian countries, the Trans-Pacific Strategic Economic Partnership (TPP) in the Asian-Pacific region).

On the basis of the observations discussed above, when we model shipping relationships trade agreement memberships should be included for two reasons: firstly, to understand the actual effects on agents involved in the agreements; and secondly, to understand the effects generated on agents who are not members of a specific trade bloc. In this regard, a CAS application on maritime international trade would help us to better assess the role of alliances in trade, the effects of the establishment of new alliances, and the admission of new members in existing agreements (Table 2 – Feature: *Emergence*).

The aforementioned are some of the questions a CAS application should potentially be able to answer when policy constraints are reckoned with the agents’ behaviour modelling (Table 2 – Feature: *Distributed control*). Referring to Holland’s classification, the modeller has to set up the internal model of each agent so that it takes into account the distinguishing factors an agent uses to direct its economic choices. For example, national and international port alliances are nested clusters of ports. A single port may belong to a cluster of ports at national level and also belong to a cluster of ports at international level. But not all ports in a national

cluster are necessarily part of an international cluster; these structures emerge during the mutual interactions between agents.

CONCLUSION: CHALLENGES, BENEFITS AND FLOWS OF CAS

The global financial and economic crisis of 2008 has made vulnerable the intricate chain of activity which comprises the maritime industry. Rapid growth since 1980 in the volume of freight handled, technical improvements and logistics reorganization has prompted the development of complex interactions among independent agents in the maritime industry (i.e. shipping companies, commodity producers, ports and port authorities, terminal operators, and freight brokers). From this perspective, maritime industry may be considered as a system composed of interacting, intelligent and adapting elements. Under this lens of analysis, Complexity theory and Complex Adaptive Systems (CAS) provide us with an established theory and mathematical toolkit for the study of maritime industry. Opposite from classic top-down approaches whose modeling components are carefully designed and evaluated, the CAS theory proposes bottom-up methods based on the modeling of simple interactions among its components (or agents) that generate complex, robust and flexible phenomena and macro-regularities.

Our aim in the present paper has been to review the maritime literature and demonstrate how CAS theory can be applied in the maritime industry in order to achieve the following objectives:

- to test the stability and efficiency of the maritime container shipping industry to endogenous and exogenous shocks such as global downturns and piracy attacks,
- to understand the spatial structure and organization of the formation of regional clusters of ports, business agglomerations and industrial alliances,
- to understand why certain types of co-operation among shipping firms appear to be more adaptable than others, and to know which factors regulate the stable relationships among them,;
- to provide policy makers with a set of comprehensive tools able to address issues of growth, distribution and welfare connected to global trade trends.

For instance, a crucial problem upon which a CAS approach may be able to shed some light is the assessment of the resilience of the maritime industry system to shocks. In recent years, in conjunction with the rapid growth in shipping, piracy attacks have increasingly been carried out on cargo vessels. Their goal has been to kidnap personnel on board and force companies to pay high ransoms for their employees' lives. This activity is presently impacting on the logistics management of carriers. In fact, among other preventative measures applied by management, carriers are changing their routes in order to protect their vessels from attack. Especially in the proximity of the Horn of Africa, where most attacks have taken place in the last few years, we have registered an increase in changes of routes, where vessels have tended to navigate as far away as possible from coastlines. Thus, in the case of piracy we are observing an adaptation of the maritime system to external factors that are also driving economic and political changes in areas affected by these phenomena.

In addition to the problem of piracy, the recent financial and economic international crisis has caused a breakdown in the container industry. In response to this external shock, co-operation among container companies has increased. In order to stay profitable in the present unstable market, carriers have gradually adopted co-operative schemes in a number of container services [59], thereby creating new options for carriers that can adapt their financial strategies in order to share the level of investment as well as the financial risk.

We can conclude by observing that the CAS approach, beyond other econometric approaches, may be more suitable in the aim to reproduce dynamic and rapid changes of markets [13].

The challenge now is to set up an integrated multidisciplinary approach in practice. Scholars have already thrown down the gauntlet to the scientific community of a multidisciplinary approach using the CAS paradigm [13, 56] alas, not yet in maritime shipping.

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REMARKS

¹Source: World Container Traffic – Drewry Annual Reports; End Year Fleet Size – CI Market Analysis: Container Leasing Market 2010.

²For an extensive review of complex networks, see [30-32]

³A measure of the tendency for nodes to cluster together.

⁴In Network Theory degree k represents the number of connections of every node.

⁵In the case of ship networks, Strength represents the sum of goods passing through a port in one year: the sum of the links' weights that converge on a node.

⁶The Betweenness Centrality of a node is the number of topologically shortest paths that pass through that node.

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PREGLED INDUSTRIJE POMORSKOG KONTEJNERSKOG PRIJEVOZA KAO ADAPTIVNOG KOMPLEKSNOG SUSTAVA

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SAŽETAK

Razmatramo li svjetsku industriju pomorskog kontejnerskog prijevoza kao sustav, opažamo kako veliku ulogu u postizanju utjecajnih pozicija i rastu tržišnog udjela ima velik broj neovisnih racionalnih agenata poput lučkih uprava, prijevoznika, brodarskih tvrtki i proizvođača robe. Industrija brodskog prijevoza se može, s tog gledišta, definirati kao adaptivni kompleksni sustav sastavljen od relativno neovisnih dijelova koji konstatno traže, uče i adaptiraju se svojoj okolini, dok njihova međudjelovnja oblikuju prepoznatljivije oblike. U ovom radu razmatramo industriju brodskog prijevoza kao adaptivni kompleksni sustav. Iako su adaptivni kompleksni sustavi primjenjivani u proučavanju bioloških i društvenih sustava, njihova primjena u pomorskom prijevozu je oskudna. Stoga je naš cilj u ovom radu navesti literaturu koja pristupa međunarodnoj pomorskoj industriji sa stajališta adaptivnih kompleksnih sustava. Također navodimo neke od ciljeva koje se može postići primjenom pristupa adaptivnih kompleksnih sustava posebno na industriju kontejnerskog prijevoza. Konstrukcija trajnog ontologijskog okvira pružit će opsežan pogleda na pomorsku industriju te omogućiti ispitivanje stabilnosti i učinkovitosti tog okvira na unutarnje i vanjske udare.

KLJUČNE RIJEČI

međunarodna trgovina, industrija pomorskog kontejnerskog prijevoza, adaptivni kompleksni sustav

PUBLIC ADMINISTRATION – MAIN FACTOR IN SUCCESSFUL MANAGEMENT OF COASTAL AREA DEVELOPMENT IN REPUBLIC OF CROATIA

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ABSTRACT

The modern society requires a rational, professional, stable and socially accountable public administration that serves its citizens. Analysis of the status and functioning of the Croatian public administration shows that there are still many shortcomings and problems that must be solved. This paper outlines the basic characteristics of public administration as a set of structures and processes aiming to start and implement the policies in accordance with the public interest. Also, it explores the way and the level of success of managing the common good, with special attention given to the management of the coastal area, whereas the management of the coastal area is defined as an activity comprising different levels of management – local, regional, national and international. The author stresses the need to coordinate the different levels and emphasize the importance of organizing the work process and the capabilities of the managing structure. This is necessary because the public administration often makes decisions directly influencing the citizens' quality of life on a local and individual level. Given that the public administration has a great amount of power in all countries, it must be controlled. The author states that beside self control of public administration it is also needed to conduct the additional control. That kind of control is necessary due to the inestimable value of Croatia's coastal and other resources. Based on the results of the research the author suggests measures to improve a continued and efficient control.

KEY WORDS

public administration, management, coastal area, organization, strategy, control

CLASSIFICATION

JEL: H1, O1

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INTRODUCTION

The citizens expect the public administration to be efficient, competent, modern and to be kept within the framework of the country's budget, both today and in the future. Public administration in all its domains (wealth, security, education, transport, traffic and etc.) must recognize the citizens' needs and the society's possibilities and strive to meet European standards. Such public administration is considered a partner by a democratic society. A transparent administration cooperates with the citizens; it is open, friendly, professional and responsible. If efficient, administration does not represent a "cost", or more efficient the cost is always here, but there is a possible significant benefit. The administration's structures must be simple and coordinated. The civil society has a responsibility in controlling public administration.

Author's analysis of the Croatian public administration shows that these characteristics are only partly implemented in the administration's functioning. This is especially true for the management¹ of the coastal area and its development, which has been entirely given to the public administration on different levels with overlapping powers (national, county, local). Managing the development and natural resources, especially those of the coastal area, is a complex and dynamic activity which entails the meeting, clash and cancelling out of different aspects (such as economics, ecological, legal, ...) and hence requires the public administration to be transparent and efficient. Meanwhile, due to the system's complexity it is not always possible to foresee the outcome, which is why managing decisions are necessary, but they must be grounded in trustworthy information and the decision maker's responsibility.

This paper aims to point to the complexity of the public administration and the importance of its continual control in order to establish and delegate responsibilities. Also, it wishes to suggest suitable measures to improve the public administration's efficiency based on the analysis of current state.

THE CHARACTERISTICS OF PUBLIC ADMINISTRATION IN THE REPUBLIC OF CROATIA

Public administration from its beginning as an institution had a numerous reforms. The reforms included:

- 1) transition from a patrimonial² to professional management, but to this day the public administration continues to be a central institution of the state system,
- 2) instead of a vertical there was a horizontal functional integration, that is, differentiation by which the society is changed and adapted through specialized activities, professions and institutions, and the public administration becomes one of the specialized areas. Within these units the public administration still retains a vertical administrative hierarchy,
- 3) in parallel with the differentiation of the society there was an inner differentiation of the state, that is, governmental and other organizations appear around the public administration and related organizations, through which the government achieves its objectives.

Nowadays, in the 21st century, Croatia's public administration and public enterprises engaged in activities of public interest brings together governmental and other organisations and constitutes the public sector. Public administration activities are: (i) direct implementation of laws and adoption of legislation for their implementation, (ii) carrying out administrative supervision and (iii) other administrative and professional activities. These activities may be delegated to local self-government units and legal entities outside the state system that have public authority. In order to clarify the relation between the public administration and the state it is important to stress that the public administration's only source of financing is the state budget.

The present local self-government system in Croatia was established in 1993, when the act defining the territorial organization, scope of self-governance, election system and financing of local self-government was passed, and it was brought to life with the first local elections [1]. Local self-government units are municipalities and towns and cities, while counties are regional self-government units. Croatia has established a total of 555 local self-government units, out of which 429 municipalities and 126 towns and cities, and 20 regional self-government units, that is, counties. The City of Zagreb, the capital of the Republic of Croatia, has a special status of both a city and a county³.

Author's analysis of the work of Croatia's public administration indicates that:

- 1) it is fragmented and inefficient,
- 2) for the most part it cannot be self-financed and it has too much staff,
- 3) its operation is too sluggish and bureaucratic,
- 4) it often employs unskilled staff in crucial positions.

There are many opinions on the level and form of decentralization that Croatia requires. The opinion of the profession is that the priority in the public administration reform should be its decentralization and specialization. Although the dynamics of the reform is defined by both financial and actual capabilities, it is necessary to encourage decentralization and convergence of the administration to citizens. Strengthening political accountability, transparency of work and decision-making would help achieve positive results of decentralization. However, lack of central control with regards to the protection of legality, financial operations and citizens' rights could prove to be dangerous. The author believes that the goal should be to strengthen the laws, because that entails the possibility to achieve balance of these requirements.

PUBLIC ADMINISTRATION AND MANAGEMENT OF THE COASTAL AREA IN THE REPUBLIC OF CROATIA

It is an indisputable fact that the coastal area, the sea and islands are Croatia's greatest natural and economic resource. The coastal area (Fig. 1) and islands are also the site of dynamic and inter-related natural processes fuelled by the interaction of the sea and the land and an area affected by development pressures. The length of Croatian coastal line is 6278 km, from which 1880 km is land part and 4398 km island part. It is important to mention that Croatia is the 3rd state in Europe by measuring the coastal line [2; p. 293].

The Croatian coast and the possible adverse effects that have or may have unwanted consequences regarding ecological systems have not yet been properly identified and evaluated. Recently the Adriatic coast has seen a decrease in industrial production as a result of transition, that is, privatization, and less due to improved awareness.

Croatia is a developing country struggling with many limitations when it comes to managing the development of the coastal area. However, due to the fact that it is not completely developed, it has many advantages and possibilities compared to other coastal countries. Tourism plays a major part in Croatia's development. Its development entails the improvement of other sectors of the economy. A long history of coastal planning in Croatia has resulted in the preservation of many valuable areas along the coast despite pressures created by urbanization, industrialization and constructions due to tourism in the last few decades. A partially established demesne management system through a concession also contributes to this. These are all advantages compared to the coastal countries that emphasize the importance of private property and have sold parts of their coast and legalized property over demesne.



Figure 1. Croatian coastal regions (according to <http://sajt.com.hr/naslovnica/wp-content/uploads/2010/12/Geografski-aspekti-upravljanja-obalnim-područjima.doc>, p. 5, modified by the author).

Considering the limitations in managing the development of coastal area, they are primarily related to the functioning of public administration and its organizational and professional capabilities. Furthermore, there is also the choice of development path, and it is logical that every intense growth leads to uncontrolled development and has unwanted consequences to ecological systems. Islands are the especially threatened parts of Croatia's coastal area. The problem also lies in the social and economic state of the islands. Government's measures to improve the position of the islands so far have not yielded positive developments, despite the existence of a strategy on a national level. Migration and decrease in the number of population are still the dominant social and economic characteristics of Adriatic islands. Another challenge the islands face are the municipal problems. Due to limited area and weak utility services, the possibility of managing solid waste on the mainland is also being considered, among others. A part of these problems is also present in the coastal area.

Despite many planning documents on the establishment of a comprehensive coastal area managing system, it has not been yet implemented [3; p.1051]. Another major problem is the lack of appropriate cooperation between the relevant ministries and state administration. There are no specific norms in the existing legislation that would target the management of the coastal area as a whole. There are no sufficient capacities to prepare the different plans in accordance with the EU legislation and requirement; also there are difficulties in implementing the legislation adopted on a national level and its implementation on the local level, that is, policies that are not easily implemented on lower levels. Also, discrepancies between the laws governing coastal management and organization have been identified.

Other than the problem of institutional capacity, there is also a problem on the level of intellectual capacity [4] which is not in the function of managing the coastal area. The public

administration has problems with implementing the modern methodology in managing the coastal area due to lack of knowledge and practical skills. However, even with the deficiencies in using the geographic information system (GIS) for the purposes of coastal planning and managing certain results have been accomplished. Most municipalities and towns, as well as state-owned enterprises managing the infrastructure now have digital databases. The problem lies in integrating these databases into a joint information system.

In the area of spatial planning a significant number of experts, planners is now in smaller businesses, whose primary interest is to remain on the market, and there are not enough investments in the development and the implementation of methods and techniques.

Also it is necessary to state that regardless that public administration at the state level and local self-governments are the part of the same organization regarding managing and developing the coastal area their goals sometimes are very different. For example the local government for specific port area planes in their official documents (such as county spatial plans) that this area will be the green zone but the state for the same area plans to build a new container terminal and because this area falls in domain of port of international significance it will be built a container terminal regardless the opinion of local government or their citizens. Also there are examples of the lacks of effectiveness of public administration on both levels in terms of managing coastal area. For example the local government (special body of local government - Department of the maritime domain and concessions) gives a concession of the beach to a private subject A and in the same time the different body (state or local) gives the concession of a hotel connected to the beach to private subject B. So, now there is situation where guests of the hotel near sea cannot use the beach and as the result of this conflict or mismanagement is poor business performance of both private subjects and termination of the concession from by one of the subjects.

Thus, it can be concluded that managing the development of the coastal are through public administration should ensure advantages on both state and local level in order to improve the quality of life, whereas public administration must create the necessary preconditions to ensure an equal development.

FUNCTIONS AND INSTRUMENTS OF PUBLIC ADMINISTRATION RELEVANT TO THE DEVELOPMENT OF THE COASTAL AREA

Coastal areas are very complex regions subject to economic activities and natural structures; hence, conflicts, as well as the incompatibility of structures are often inevitable. In order to prevent this, it is important to continually prepare the information needed so that informed decisions on a problem are made. Here the aggravating circumstance is that the jurisdiction of institutions relevant for certain activities is not always horizontally integrated. The place of making decisions is on different levels, as well as the origin of the conflict of various levels, from national to international.

The problem that appears in institutionalizing the management of coastal area is an organization's success and capability to act on various levels, as well as the coordination between specific levels and organizations. According to the research and recommendations of Organization for Economic Cooperation and Development, the activities of spatial planning and of environmental agencies should made on national, regional and local level, while authorities for water and urban infrastructure should be established exclusively on local and regional levels [5]. Also, agencies for specific economic activities should be established on a national and local level. There must be appropriate links and flow of functions must exist between vertical and horizontal managing units. Given that the managing structure on a local level often faces development pressures, it must be competent and efficient and act proactively.

FUNCTIONS AND ACTIVITIES OF PUBLIC ADMINISTRATION IN MANAGING COASTS AS A SPECIAL AREA

Managing coastal area and its development entails activities not different from the activities in a business system. These are planning, managing, deciding, monitoring and evaluating. Planning regulates and defines pre-planned tasks that must be carried out in the future, including the necessary activities and means that must be used to achieve the optimal objective and appropriate results. Project managing is the basis of managing and can be defined as giving instructions and guideline in achieving the desired goals. Deciding and choosing the optimal decision removes obstacles and enables continual marching towards the future and thus ensures development.

Planning allows public administration to choose modalities and instruments to manage development of the coastal area. Hence, the following actions are necessary:

- long-term planning policies should be made into short-term ones,
- objectives and plan guidelines should be transformed into specific and recognisable elements of development,
- general and global plans should be defined through strategic projects, and
- major uncertainties should be made less uncertain and in accordance with the development.

Planning activity is finished once a plan to be publicly presented to users and performers of specific activities in the coastal area is made.

Managing must be based on trusted and accurate information. Otherwise, it is difficult to make the right decisions. Thus, it can be concluded that the information system is an important factor of the decision-making process, but also of the entire coastal area management system. The public administration has a number of different data, from those related to the natural system, to those concerning human activities and laws. This data must be used transparently and responsibly, because the decisions that are not made on time or are wrong affect the development, and the society as a whole.

This is why monitoring is necessary. Monitoring means a set of activities, from surveillance and evaluation of state of the environment to determining the need to intervene in the environment [6; p.345, 7]. Monitoring means not only passively gathering information, but also actively analysing and evaluating the state of the environment. The role of monitoring in the management of coastal area is to directly contribute to the protection of natural resources by evaluating the state of the environment and to encourage a positive relation in coastal areas in an indirect way.

Within the framework of public administration monitoring is performed by the part of system (input sector). Monitoring is established within the relevant institutions and administrative services directly responsible for development and the environment, and many data has already been saved in these institutions. In this case it is necessary to gather them in a unique database from which it can be used in the process of evaluating certain areas. If the data has not been collected and saved in a unique database, it is necessary to implement monitoring through institutes or institutions of higher education.

The process continues by analysing the collected data in order to establish to what extent the activities of the coastal management programme are targeted towards the problems defined by objectives and their solution. If the evaluation process shows that there is a need to adapt the functioning of the programme, the work methods should be evaluated before they are implemented.

PUBLIC ADMINISTRATION INSTRUMENTS IN THE FUNCTION OF THE DEVELOPMENT OF COASTAL AREAS

Programmes and projects and measures and instruments are the instruments public administration uses to perform its activities on a regional and local level and to shape its processes and actions in order to achieve sustainable and permanent development, regulate natural structures and social activities processes.

One of the most common ways of managing the coastal area is educating the population of all strata focusing on recognising and preserving the basic cultural and natural values. Public management projects are focused on the encouragement and implementation of modern technological solutions into a outdated and inert economic structure. Spatial plans that have a long-term effect on the development of the coastal area by defining the activities of a certain area hold a special place [7].

The next type of public administration instruments are so called “measures” and their means. All branches of the economy strive to achieve the greatest possible success and use, while ignoring the consequences of the actions of economic activities. Public administration as a representative of authority, regardless of management level, encourages people to change their way of life and work even with interventions. There are two ways of intervening in protection and improving the environment:

- laws and regulations and
- stimulations which are altered arbitrarily.

Laws and regulations mean a strategy widely used at all levels of government and for all purposes. Stimulations changed arbitrarily as economic instruments are not as widely implemented as laws and regulations. Laws and regulations are a part of the basic factors of the institutional infrastructure and entail the use of certain permits based on either established criteria or actual implementation. Permits containing the power of regulation are usually standardized because they are easier to implement in such form.

Stimulations almost always use the economic instruments because it the basic purpose is the creation of a monetary incentive aimed at potential polluters to reduce pollution within their scope of activities. Here the government policy which aims to improve the environment by producing monetary stimuli for voluntary and not obligatory decrease of action stands out. Monetary incentives appear in two basic forms: as new income or as avoided cost. This type of instruments has been used in the USA for more than thirty years, and it was first applied in Europe in 1980.

The use of such instruments appeared because laws and regulations as regulatory instruments had become inefficient. In contrast, stimulations as economic instruments have been proven as more efficient, promotive, stimulative and restrictive.

PUBLIC ADMINISTRATION CONTROL

Public administration has many powers in all countries, which is why it requires a high degree of control. Given that control is a continued control activity the authorized subjects exert over the behaviour of the administration, the way it uses its authorities and acts [8], in case of Croatia this control must be not only continued, but also efficient. Here it is especially important that citizens directly participate in the decision-making process as well as the appropriate political representation, because such model created the premise of rational management and the rule of the philosophy of governance in the local self-government. The control of public administration presupposes the control of legality and the control of purposefulness.

MEANS OF POLITICAL CONTROL OF PUBLIC ADMINISTRATION

Means of political control are the means aimed at influencing the public administration with regards to its role in the mechanism of political power, that is, the political system. Very early on people became aware of public administration's potential to serve as a stronghold of the government. Therefore they tried to limit and weaken this potential. On the one hand, control over the public administration means verifying whether the public administration works in accordance with the political, technical or legal criteria on which its actions are based. On the other hand, it means that the legitimate holders of supervisory power may have a crucial influence on the administration and veer it towards an efficient exercise of its objectives in an optimal manner [8]. Pusić divides the means of political control into two main groups: organizational and functional [9].

Means of political control of the public administration are not an exclusive characteristic of democratic regimes. Some of these means are implemented in various types of undemocratic and even totalitarian regimes. Therefore, we can call them means of political technique.

According to Pusić, a successful implementation of functional means implies those exerting control are timely and reliably informed on the state of affairs and also implies the administration's responsibility to work in accordance with the set criteria, including the practical possibility to sanction the officers and civil servants of public administration [8]. The citizens' ability to make decisions as a form of means of political control signifies that all citizens through their chosen delegates take part in influencing decisions and making decisions related to the public aid.

PROMOTING POLITICAL, PUBLIC ADMINISTRATIVE AND CIVIC RESPONSIBILITY

The issue of responsibility in public administration is the fundamental issue related to control. Responsibility is examined with regards to action in accordance with some criteria. Responsibility also includes the practical possibility of sanctioning decision-makers, the administrative structure and employees, that is, public administration officials. The citizens' ability to make decisions as a form of means of political control signifies that all citizens with political rights take part in making the decisions related to public administration through their elected representatives. However, there are limitations that hinder the process of the development of Croatian civil society related to the low level of participation on the part of the citizens and the financial problems of the middle classes (such as financial). It is a fact that civil society cannot flourish without the development of the citizenship. Citizens have no experience in organizing and influencing the decision-making process.

Public administration is distrustful to civil initiatives, and Croatia's civil society is still in its early development stage. It is marked by a low degree of civil behaviour characterized by very low level of participation of citizens in civil organizations and volunteering and giving for the purposes of the common good. Public administration and civil organizations share a relatively low level of cooperation. The existing relation is mainly related to giving financial means to organizations. The partnership of public services and civil organizations is still an unknown concept to the society. Various administrative bodies, civil and public, are relatively unknown. However, it is encouraging that a growing number of commissions on important social issues include the representatives of the civil society.

CONTROL OF PUBLIC ADMINISTRATION AS AN INCENTIVE TO THE MANAGEMENT OF THE COASTAL AREA

In order to achieve efficient management of the coastal area, one of Croatia's greatest resources it is important to have an appropriate system of control over all public administration bodies

that are involved in the managing process in any way. Such system implies clearly defined goals for the management of the coastal area, the existence of continuity in monitoring their implementation and the ability to act and take appropriate measures when necessary. The control system in the field on managing coastal area is implemented through four basic subsystems:

- political system, which defines long-term coastal management objectives and the criteria for the implementation of different scenarios,
- legislative system, all applicable international conventions, national laws and regional/local regulations necessary for the implementation of this policy,
- financial system, which ensures the necessary financial means, and
- executive system, which defines the scope of responsibility for all activities related to the management of the coastal area.

MEASURES AND RECOMMENDATIONS FOR THE IMPROVEMENT OF THE PUBLIC ADMINISTRATION SYSTEM IN MANAGING OF THE DEVELOPMENT OF THE COASTAL AREA

Analysis of interest groups [10] represents one of the crucial steps in the management of the coastal area. The next step is the solution of problems, which is the process of observing and establishing and bridging the gap between the current situation and the objective. That is, a long-term accomplishment, and it is represented in general, for example, as the improvement of results in shipbuilding and port activities. The decision-making process, a vitally important step towards the achievement of the objective is a selective process of choosing the solution that will most probably help achieve the desired objective among two or more solutions. The public administration management is expected to:

- 1) abandon the traditional way of thinking so that public administration can become an intelligent organization based on intellectual capital [11], which encourages development. This is achieved by defining the individual objectives:
 - economic – a systematic evaluation of sea and coastal resources based on the principles of sustainable development for the purposes of efficient management,
 - social – increasing the standard of living of the population of the coastal area while respecting the principles of the organization of space and the needs of the people living and working in the area,
 - ecological – sustainable development of sea and coastal resources, their rational use and protection in all elements and stages of their use, as well as the encouragement development while respecting a holistic approach,
- 2) strives to the efficient management of sea and coastal resources as a special objective through the implementation of a function and organization model based on the modern decision-making theory and implementable models and modern information systems.

Public administration control and its responsibility in managing the public good by acting in accordance with the common good has a special importance in today's world of globalization and the promotion of interests of capital and ownership. On the one hand, control over the public administration means verifying whether the public administration works in accordance with the political, technical and legal criteria on which its actions are based. On the other hand, it means that the legitimate holders of supervisory power may have a crucial influence on the public administration and veer it towards an efficient exercise of its objectives in an optimal manner. The most important organizational means of political control is decentralization. Decentralization means any weakening of influence of a certain centre of an

organizational system on the parts of the system. This means that political control can be implemented in order to diminish the influence of certain centres of political power on certain centres of the public administration, and also to loosen the ties between the administrative apparatus. The responsibility of public administration, which is at the service of the citizens, is seen in its acting according to the set criteria. Public administration has the moral and every other responsibility in acting and making decisions on matters of public interest for all activities it does by using the means and resources (the common good) it has been entrusted with.

The spatial planning measures necessary for the achievement of an equal and balanced development of the coastal area are:

- reducing the gap between the process of making the plans and the process of implementing the plans: This is a general problem affecting many countries and it is difficult to eliminate because different functions are often given to different organizations. However, certain mechanisms and instruments can be introduced to reduce the gap. Regional management is an approach which is a part of the new modes of governance [12]. New modes of governance are focused on the development process and require certain social and emotional skills (soft skills, teamwork, group management, communication abilities, etc.), but also the networking of planners and enforcers, efficient control instruments, etc. Croatia, which is about to access the EU, now has a greater possibility to create and manage an efficient regional development policy. Identification of the Adriatic region in accordance with the European classification of statistical regions has created clear territorial and spatial basis for the formulation of the policy of integral management of the Adriatic coast.
- expanding and strengthening the coordination capabilities of spatial planning: Spatial planning serves spatial coordination; however, it faces limitations when it comes to coordination with other dimensions (time and content). Coordination efforts surpassing spatial planning would be easier achieved within the framework of regional development programmes. After the latest changes in the Croatian legislation related to spatial planning and construction, as well as environment protection, today the jurisdiction for these areas and spatial programming is given to county self-government units [13]. Technically, it has enabled a harmonized cooperation. However, in reality frequent organizational division of labour forces causes the establishment of different departments, institutes, enterprises and agencies, which hinders the process. The creation of different regional development programmes which are being processed will enable the definition of the existing state and of new objectives, measures and instruments for their implementation, and the establishment of set planning objectives control and evaluation mechanisms. This is why it is necessary to group activities through only one organizational form and the author suggest that an agency for the management of the coastal area development be established. It would collect data and work proactively for the development of the coastal area.

CONCLUSIONS

Democratization is a basic value developed through political decentralization and the strengthening of local self-government and through economic values such as efficiency, effectiveness and frugality. The expansion of political decentralization and local units autonomy can by no means affect the autonomy of public institutions performing local public services, that is, firm control by the central government must not be replaced by an equally firm control exerted by local political elite.

The realization of these values is possible through the expansion of the scope of local activities (such as preliminary projects, in depended and higher budget and similar) autonomy of local units in the process of making decisions and conducting public activities and reducing the control of central government administration, strengthening local units capacities for the economical, efficient and effective performance of activities and ensuring the equality of citizens and a more effective civil rights protection.

The management of the coastal area and its development has been entrusted to the public administration and bodies with special authorities. It is a process in which complex decisions are made. Decisions are not usually made by one participant, but they are rather a result of different activities and plans of all interest groups. They come from different sectors (domains) and work on different institutional levels, and each must be timely and appropriately informed.

Coastal area management deals with contradictory problems of different sectors such as spatial and regional development, environment protection, zoning, economic development and aspects of social and cultural development. At the same time coastal areas always represent a part of the local territory and are within a specific region. That is why it is necessary to bring the local processes closer to citizens through decentralization within the local units and creation of conditions for rationalization of their territorial structure. To achieve this it is necessary to consider development as a qualitative measure which requires a holistic approach, especially on the part of management structures. This implies the functioning of the total coastal area development strategy because each change in any element causes consequences affecting the entire coastal area.

REMARKS

¹Coastal area is a resource subject to intense economic activities and, consequently, conflict and incompatibility of structures is often inevitable.

²Paternalism, derived from the Latin word *pater*, meaning father, signifies a relation in which the administration has a paternal attitude towards its citizens. The citizens were treated as children, and not adults, which is why the ruler and its administration should look after them. The administration knows what is good for the citizens and runs the public services and the entire country accordingly, and the citizens must obey and accept that the administration is older and smarter.

³<http://www.uprava.hr>.

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JAVNA UPRAVA – OSNOVNI ČIMBENIK USPJEŠNOG UPRAVLJANJA RAZVOJEM OBALNOG PODRUČJA REPUBLIKE HRVATSKE

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SAŽETAK

Suvremeno društvo zahtijeva javnu upravu koja je servis građana, racionalna, profesionalna, stabilna te društveno odgovorna. Analiza stanja i funkcioniranja javne uprave u Hrvatskoj pokazuje da postoje još brojni nedostaci i problemi koje treba otkloniti. U radu se utvrđuju temeljna obilježja javne uprave kao skupa struktura i procesa čiji je cilj ostvarivanje javnog interesa, tj. opće dobro. U radu se istražuje način i uspješnost upravljanja općim dobrom, s posebnim osvrtom na upravljanje obalnim područjem Republike Hrvatske. Pri tome se upravljanje obalnim područjem definira kao aktivnost koja obuhvaća različite nivoe upravljanja, lokalni, regionalni, državni i internacionalni. Autor u radu ističe potrebu koordinacije između navedenih razina te naglašava važnost organizacije procesa rada te posebno važnost sposobnosti upravljačke strukture. To je nužno budući da javna uprava na lokalnoj i individualnoj razini često donosi odluke i strategije koje imaju direktnu posljedicu na kvalitetu života građana. Svaki sustav strateškog menadžmenta ima fazu kontrole, pa tako i javna uprava. Autor smatra da osim samokontrole javne uprave potrebna je i dodatna kontrola. Ta kontrola neophodna je i zbog neprocjenjive vrijednosti obalnih i drugih resursa kojima raspolaže Republika Hrvatska. Na temelju rezultata istraživanja autor predlaže mjere za poboljšanje kontrole koja mora biti kontinuirana i učinkovita.

KLJUČNE RIJEČI

javna uprava, menadžment, obalno područje, organizacija, strategija, kontrola

MODELLING THE DYNAMICS OF SECURIZITATING NATIONAL IDENTITIES

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ABSTRACT

Using the example of conflict escalation in former Yugoslavia, a common framework of the mechanisms leading to conflict escalation is developed in this paper. Escalation of ethno-nationalist violence is described as an endogenous feature of the nation. The principle of the nation may succeed in being an organising principle for integrating large-scale social groups. However, it may also generate the extreme event of ethno-nationalist violence. The architecture of a simulation model is described to test the extreme event hypothesis.

KEY WORDS

Yugoslavia, conflict escalation, securitization, extreme events, nationalism

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INTRODUCTION

Twenty years ago, a war broke out in the midst of Europe: unlike the peaceful secession of Czechoslovakia, for instance, which occurred at around the same time, the breakdown of Yugoslavia was extremely violent. It was the first time the phenomenon of war had occurred in Europe since World War II. What is more, the series of wars went hand in hand with serious crimes that captured the attention of the world community. It is tempting to state that a number of these crimes were of a rather different nature to war crimes committed in conventional interstate wars. While conventional wars are characterised by the order and command structure of the armed forces (although it might have been questioned inasmuch, people took advantage of it), the Yugoslavian case provided a paradigm for so-called ‘new wars’ [1]: in fact, most attempts to recruit Serbian people to serve in the army to fight these wars failed. Desertion was more the rule than the exception [2]. On the other hand, actions and – in particular, crimes – were undertaken by citizens who were not part of any organised armed forces¹. People chose voluntarily (and not by command) to commit crimes in the name of the nation. In the process, the events in Yugoslavia changed the dominant perspective on security issues. While the Cold War era was dominated by a focus on state issues, the Yugoslavian case changed the perspective from the state to society [3]. While not uncontested [4, 5], this went along with a new awareness of a seemingly increasing number of ethnic conflicts [6-9]. Thus, these wars provide a new perspective on the old question of why people should die (and murder) for an obviously symbolic construct such as the nation.

The fact that these wars now lie roughly 20 years in the past may give us the opportunity to reconsider them from a more distant perspective. Since the wars have already been the subject of numerous detailed scientific investigations, no completely new or different facts and causes are expected to be uncovered. Yet it remains controversial whether Yugoslavia should not have been an impossibility in the first place (the ‘ancient hatred’ hypothesis) [10] or whether it was a victim of Machiavellian politics (the ‘manipulation’ hypothesis) [2]. However, historical explanations typically focus on the question of why and how a particular event (in this case: the wars) were realised. This overlooks that peace is also an event that is in need of an explanation [11-13]. It is a different question to ask: Why was Yugoslavia possible in the first place? In fact, until the 1980s it was the most developed south-east European country and one of the first candidates to join the European Union. The purpose of this article is to provide a joint framework to explain peace *and* conflict by considering crimes in the name of a nation (or an ethnic group) as an extreme event of a self-organised process. We shall follow the perspective pioneered by [14] to apply the theory of self-organised criticality [15] to security issues. While [14] focused on interstate war, this approach will be extended here to ethno-nationalist secession and civil wars. It is well-known that nationalism and racism have been the cause of numerous massacres. Nevertheless, compared to ordinary times, ethnic massacres are rare events. By the 19th century at the latest, the nation-state had become the dominant mode of the organisation of political regimes. Numerous nation-states exist quite peacefully. This means that exogenous causes should not be sought², but that such events should be regarded as an endogenous feature of the system. It will thus be asked how ‘ethnic’ conflicts may – or may not – arise from the particular organisation of political regimes, known as nation-states. This leads to the hypothesis that the very same structures that generate social order (by the principles of the nation) can also generate anomic social conflicts.

The paper will elaborate this hypothesis in the following manner: *firstly*, a brief overview of the explanations found in the literature will be given. *Secondly*, a brief outline of the theory of the nation-state will be provided. Here terminology will be introduced to enable, *thirdly*, the case in question to be integrated into the framework of extreme event statistics. Moreover, in

this third section it will be argued that the statistical investigation is in need of a simulation approach to define a basic population, and the motivation behind the modelling concept will be given. *Fourthly*, the model architecture will be outlined. The paper *finally* concludes with an outlook on general insights.

TRADITIONAL EXPLANATIONS

In the following, we will give a brief sketch of the events leading to the initial phase of the conflict escalation until ethnic homogenisation took place for the first time. An overview of the explanations will then be given.

THE CONFLICT ESCALATION

The constitution of 1974 described Yugoslavia as a multi-national federal republic, consisting of six republics. Each republic comprised one of Yugoslavia's constituent nations. The territories of the republics were drawn along historically established borderlines. This goes back to the history of the founding of the first Yugoslavian state after World War I. During the wars in the 1990s, Yugoslavia collapsed along these borderlines. In the following, a brief overview of the escalation process will be given up to when the point of no return was reached. Subsequently, a brief classification of the core explanations in the literature will be outlined [16, 17].

Soon after Tito's death in 1980, rumblings could be heard in Kosovo in 1981 [18, 19] that went hand in hand with ethnic tensions between the Albanian and Serbian inhabitants of the region. After Tito's death, nationalist movements emerged in the political landscape. The beginning of the conflict was triggered by a power struggle within the Yugoslavian Communist Party about Tito's legacy. Formerly, communist politicians took advantage of ethnic sentiments, allowing them to organise loyalty with an ethnic agenda. In particular, Milosevic's rise to power is well documented [20]. Essential elements of his strategy provoked nationalist prejudices and attempts to establish Serbian dominance among the federal republics. Particularly well known is the speech he delivered in April 1987 in Kosovo Polje when he promised the local Serbs that 'no one should beat you'. He was able to stimulate mass movements in Montenegro and the Vojvodina, bringing liegemen of Milosevic into power [21]. The power struggles at the end of the 1980s still took place within the Yugoslavian Communist Party, culminating in a congress of the Communist Party on 22 January 1990. Yet the first free elections in the individual republics brought nationalist parties into power, albeit often with only marginal majorities. In April 1990, Franjo Tudjman won the first free elections in Croatia³. This created a situation in which Yugoslavia had been described as a hot iron between Tudjman and Milosevic as hammer and anvil [22]. Nevertheless, the degree of ethnic mobilisation in the population was rather small. Even in 1990, the results of opinion polls in Bosnia revealed that more than 90 % considered ethnic relations in their neighbourhood to be good, even though there were already political tensions at the political level [23].

However, very soon civilians were also becoming involved in the battles and, in particular, in war crimes. The violence was not accidental, but aimed at establishing ethnically homogeneous nations out of the former multi-ethnic country of Yugoslavia. The violence of the militia was motivated by an awareness of ethnic identity. The escalation of tensions into open conflict started after Croatia declared its independence in 1991. The Krajina region in south-west Croatia was inhabited by a majority of Serbians. As a reaction to the Croatian independence, the establishment of a Serbian autonomous province of Krajina was declared on 28 February 1991, provoking armed conflicts⁴. A new stage of conflict escalation set in,

resulting from conflicting loyalties and territorial claims. A further stage was reached on 26/27 August 1991, when the first ethnic homogenisations took place in the small village of Kijevo, inhabited mainly by Croats [19]. After the village had been attacked by the Yugoslavian Army, a paramilitary militia of the Krajina Serbs invaded the village and displaced the Croatian population, destroying their houses. The militia consisted of the local Krajina Serbs, civilians who were not integrated into the command structure of the Yugoslavian army. As characteristic for the militia's course of action, they prewarned the Serbian inhabitants of the village, who chose not to pass on the information to their Croatian neighbours. This *modus operandi* turned out to be a template for later ethnic homogenisations in Bosnia-Herzegovina [19].

At this point, a stage was reached in which civilians were mobilised for the war and even to actively participate in war crimes. Presumably, a point of no return had been reached when social order disintegrated into an anomic state. The puzzling question is how people became attuned to commit such crimes.

TRADITIONAL EXPLANATIONS

This was a very brief description of the early phase of the Yugoslavian wars. Several explanations for the wars can be found in the literature. These explanations can essentially be differentiated into two accounts: one line of reasoning aims to identify the conditions that led to conflict; the other class of investigations concentrates on analysing the mechanisms of the conflicts.

Conditions

Explanations that investigate the conditions that led to conflict can be differentiated into whether they focus on international or internal conditions.

International situation. One condition that can be identified is the international situation [24, 25]. At the end of the Cold War, international relations were in a phase of destabilisation. For example, some authors stress that the early acceptance of Slovenia and Croatia by the European Union, particularly enforced by Germany, yet without possessing regulatory powers when the war escalated, was partially responsible for the escalation [26]. The unclear and too weak mandate of UN soldiers is another example. Although these factors can explain the possibility of the escalation, they cannot explain why it took place in the first place. This line of reasoning provides a prime example of explaining violent crises by 'external shocks'. The radical change of the international situation provides a condition beyond the influence of the state that has to face its consequences.

Internal (economic) situation. We therefore have to explore the internal conditions of the Federal Republic of Yugoslavia. Classical political economy calls for an investigation of the economic situation. In fact, Yugoslavia underwent a serious economic crisis in the 1980s [27]. From the mid 1980s, Yugoslavia suffered from declining production volumes. Likewise, the republic had to face a dramatic increase in the inflation rate. In 1989, there was even a hyperinflation of 2700 %. Together with the stagnation of wages, this caused a dramatic decrease in the standard of living. Moreover, the combination of these factors resulted in a dramatic increase in state debt. In other words, political collapse went hand in hand with economic collapse.

A comparable line of reasoning is also emphasised by accounts that question the concept of ethnic wars [5]. These accounts argue that ethnicity is not the decisive condition for conflict escalation. Nevertheless, the question remains why the conflicts escalated along national borderlines. Insofar as the economic situation may cause grievance, it can provide conditions for an increase in the likelihood of violence. In psychological terms, a variation of living

conditions, in particular if this change is very rapid, is an example of an external treatment. It may induce several actions in individuals facing this treatment, ranging from deprivation to violence. However, this cannot explain why the violence took place along national borderlines⁵.

Both the international situation and economic performance provide conditions for an increasing likelihood of violence⁶. However, they do not identify mechanisms that generate specific violent actions.

Mechanisms

At the level of explanatory accounts focusing on mechanisms, again two dimensions can be differentiated: those that focus on a political level and those that explore the matter on a cultural level.

Political level. The first and obvious answer is the recourse to voluntary action of political actors. A description of political events provides empirical material for an analysis of the political agenda and strategies of the political actors involved [2, 18]. There can be no doubt that in the 1980s and early 1990s actors from the centre of the political élite consciously escalated the crisis of the Federal Republic to reinforce their personal political power. A considerable part of the political élite gained personal advantage from the political collapse of the Federal Republic [21]. Again, these accounts emphasise the effects certain actions by politicians have on certain political systems. In this respect, this explanatory account can be compared to changing (economic) living conditions: replacing peaceful politicians by irresponsible political entrepreneurs can also be regarded as an external shock. However, this account does not answer the question why Yugoslavia was possible in the first place. We must ask why nationalist politicians became successful at a particular point of history.

Cultural level. This question is addressed by recourse to Balkan history, which has become a prominent mode of explanation. This approach emphasises the culturally entrenched ‘ancient hatred’ of the Balkan peoples as the driving force behind the conflict escalation. Wars in the very early history of the region, such as the battle at Kosovo Polje [29, 30], served as a demonstration of the impossibility of Yugoslavia becoming a nation-state. It is claimed that an explanation has to take into account cultural ties and frontiers. In fact, conflicts crystallised along the borderlines of the different religions [31] and different languages [32] within the Federal Republic. This explanation has become prominent in both journalistic and scientific discourse [10, 33]. However, this explanation is intimately related to the ideological self-justification of the political actors and does not answer the question why these ideologies became successful at a particular point in history. Recourse to cultural legacy is indeed an endogenous explanation but leaves open the question of how and why Yugoslavia became possible in the first place.

In the following, the hypothesis will be elaborated that any comprehension of the mechanisms has to take the political and the cultural dimensions into account. On the one hand, generating politicians is an endogenous feature of any political system. This refers to a kind of political dimension. On the other hand, we must explain why violence took place along national borderlines and why ethnic homogenisation was a goal in the first place. This refers to some kind of cultural dimension. This does not imply that Yugoslavia was not an impossible construct, but that the relation between the political and the cultural dimension can be described as a recursive process. This was already suggested by the brief sketch of the early phase of the escalation dynamics in which both politicians and civilians were involved. On this basis, the escalation of violence appears as an extreme event of recursive dynamics. However, to develop this hypothesis more precisely, terminology has to be elaborated that shall be derived from the theory of the nation-state.

THEORY OF THE NATION-STATE

While it remains controversial whether ethnic awareness is an ancient phenomenon⁷, it is widely acknowledged that nation-states are a modern invention [34, 35]. By the 19th century at the latest, the nation-state had become the dominant mode of the organisation of political regimes. Even though the process of globalisation now undermines the foundations of nation-states, no alternative mode of the organisation of political regimes is currently in sight. Nonetheless, appeals to national identities are able to evoke sentiments that can elicit – sometimes dramatically cruel – action.

In the 1980s, the theory of the state became dominated by constructivist approaches [34-38]. A brief sketch of the constitutive elements of this theoretical account enables us to identify central elements of the mechanisms of the operational principles of modern nation-states. Following this framework, two dimensions will be distinguished below: a cultural and a political dimension [39].

THE CULTURAL LEVEL OF THE NATION

The cultural dimension of the nation-state can be characterised as providing a form of social integration. In feudal times, kingdoms were established by ‘the grace of god’. Religion not only provided ruling authorities with legitimacy, but also organised social cohesion by ideological ties and elements of social service. Following Nietzsche’s famous phrase ‘god is dead’, this mode of integrating large social groups collapsed in the 19th century. In this respect, the nation-state evolved as a functional equivalent⁸. National states established a particular form of what was termed ‘imagined communities’ [34]. The characteristic of these communities is a sense of belonging to the nation as a kind of group. This refers to psychological principles. Such a community is constructed using the example of small groups, however, extending this idea to large social groups. The nation is regarded qualitatively as the union of a certain ‘ethnic group’, not merely as the sum of the people inhabiting a certain territory. It is therefore called a ‘community’. Since it is actually impossible to know all of the national group members personally, Anderson talks of ‘imagined’ communities. However, the idea of a national community calls on the nation-state to provide some kind of security for the vagaries of life. State duties and responsibilities range from policing to aging and health care. A prominent example from the 20th century is the welfare state.

However, the nation also has an emotional dimension. The idea of a nation typically goes hand in hand with some kind of myths surrounding its origin [37, 40]. The mechanisms to construct the imagination of a community with unknown strangers are described by cultural sociology as symbolic constructs, such as monuments, flags, etc. [41]. The construction of national monuments enables tradition to be invented [37]. During the 19th century, historical monuments were erected all over Europe for national heroes of ancient times, describing these individuals as founders of the respective nation. Such culturally entrenched symbols provide narratives for which people are ready to live and die for [41], providing culturally shared patterns to interpret and evaluate the world. Hence, the ruling system of the nation-state is associated with a form of identity. While the relation between the political élite and a nation-state’s citizens is typically mediated by the administrative apparatus, an appeal to symbolic identities can enable direct mass-mobilisation. Identities can stimulate action that is not in the direct self-interest of the individual. This became apparent in the violence in former Yugoslavia. However, the nationalist ruling system is also a form of organising social cohesion, including material and ideological dimensions. In this respect, the myth of a national community is a functional equivalent to religious communities.

In principle, the cultural dimension becomes effective by framing individual cognitive and emotional dispositions in a commonly shared manner. 'Ancient hatred' has to be activated as a motivational force for an action by a specific individual who believes this semantic category to be true. Both actions and emotions (as a motivational force for actions) are features of individuals. However, the cultural construction of the semantic category of a nation was a historical process. This framework enables the cultural dimension of the nation to be integrated into the framework of social psychology [42-44], in particular, the social identity approach [45, 46]. The national identity can be described as a form of social identity. Social Identity is a psychological mechanism that not only generates solidarity, but that also provides culturally shared patterns to interpret the world by providing categorisations [45]. Categorisations generate a semantically structured environment, including the social environment. For instance, an individual might be characterised as a male Australian surfer [45]. This description includes the categories male, Australian and surfer. Only such culturally constructed semantic categories enable us to distinguish between Serbs and Croats, for instance.

THE POLITICAL LEVEL OF THE NATION

By contrast, the political dimension of the nation can be characterised as providing legitimacy for the ruling authority [47]. Max Weber defined power as the chance that an individual can get his point across in a social relationship even against resistance, regardless of what the chance is based on [48]. However, if political power is not built purely on coercion, some kind of motivation has to be provided for the individual to obey the ruling authority. Compared to pure coercion, legitimate power has the advantage of reducing the costs required to establish power. Consider again the example that kingdoms were established by 'the grace of god' in feudal times. Thus religion was not only an instrument to organise social cohesion, but also to legitimise political power. The French Revolution may serve as a prime example that this kind of legitimisation has lost its persuasive power [35, 49]. Again, the idea of a nation provides an alternative: in modern times, god is replaced by the sovereignty of the people as the legitimate source of political power. Various versions of this principle have been formulated: beginning with Thomas Hobbes, a number of theories have been formulated based on the idea of a social contract. Later, this was often associated with democracy. Again, the French Revolution is the prime example. Yet, the principle of the sovereignty of the people need not be democratic. Neither Hobbes nor later Carl Schmitt [50], for instance, were democrats. However, the example of Carl Schmitt illustrates the role of the nation in the framework of the principle of the sovereignty of the people. Namely, the question has to be asked: Who are the people? It is now very easy to identify the people with the nation. The nation therefore provides a source to legitimate political power.

However, in contrast to the idea of a world community, a nation does not include all members of the human species. This refers to the fact that the nation has been described not only as an imagined but also as a circumscribed community [34]. The formation of national states established borderlines between the states that are not completely arbitrary (even though there were considerable changes), as was the case with feudal states. The national state is regarded as the state of a constituent nation. Such a nation, however, is restricted in space. Historical investigations have distinguished two modes of the formation of nation-states: a state-to-nation and a nation-to-state principle of nation building [51]. These modes have also been termed the western and eastern mode, which can be differentiated along the principles of citizenship law. The state-to-nation principle refers to the *ius soli* principle that individuals residing within the borderlines of the state territory are the citizens of a state. Historically, Western European countries such as Spain or France already established a certain territory in feudal times, and the nation was 'born' within this territory. This is the 'western mode' of

state building. In East Europe, however, no such homogeneous state territories were established (at least: not everywhere) prior to the emergence of the nation. On the one hand, the emergence of the idea of a German nation blew up the borderlines of pre-existing territorial states. On the other hand, in the feudal empires of the Austrian monarchy and the Ottoman Empire, nations were 'born' within the larger empires. This mode of state building implies that a nation might exceed the borderlines of a certain territory; it can also imply that a state may include mixed nations [51, 52], an example of which is former Yugoslavia. This is the 'eastern mode' of state building, associated with the *ius sanguinis* principle that citizenship is based on a birth principle. The semantic category of a nation therefore provides a means for inclusion and exclusion.

SECURITIZATION OF THE NATION

To sum up, the idea of a nation can generate social integration by providing a socio-cultural identity at a cultural level and a specific form of legitimacy for power built on this very socio-cultural identity at a political level. However, the very same principle can also develop a highly critical potential by providing mechanisms leading to the emergence of ethno-nationalist violence. This can be analysed in the framework of the theory of securitization [53]. The theory of securitization addresses the question of how security issues arise on a political agenda. Securitization is described as a speech act that declares an object of communication as being under threat⁹. For instance, the slogan 'save the whales' can be described as a securitization act. Successful securitization can then generate the perception of an emergency situation, calling for rapid, urgent reaction. This legitimises extreme means outside the normal order of the normative structure of society. The central components of successful securitization are "existential threats, emergency action, and effects on inter-unit relations by breaking free of rules" [3; p.514]. Securitization therefore also provides perceived competence – and thus legitimate power – for those political entrepreneurs who successfully communicate the aversion of the threat. These are typically the very same people who claim the existence of a security challenge in the first place. In principle, anything can become an object of securitization. However, it is essential that the speech act succeeds in convincing the audience. At this point, it is important for the nation to be an emotionally entrenched cultural categorisation. This improves the chance of the successful communication that the imagined community of a nation is indeed under threat. In contrast to state security, which threatens the sovereignty of the state, societal security [3] addresses the issue of social identity. This means that the sense of we-ness of a nation is under threat [3]. This sense of we-ness builds on the cultural dimension of the nation. The nation therefore provides a means for political entrepreneurs and career aspirants to promote their career advancement by stimulating nationalist sentiments. Using these mechanisms, the idea of a nation can enfold its critical potential. If it can be successfully communicated that the we-ness of the nation is in danger, it may be perceived as a legitimate means to avert this threat by measures such as ethnic homogenisation. This seems to be a particular danger faced by newly formed democracies [54, 55]. The political level of the analysis of the mechanisms of conflict escalation can thus be traced back to the potential securitization of the nation by political leaders, which would not be possible without the cultural dimension of the nation.

With the theory of the nation-state and securitization, the terminological framework is now available to formulate the hypothesis that ethnic conflicts are an extreme event of a self-organised process: insofar as the nation can be constructed as an object of securitization, the very same mechanisms that generate social integration have the potential to generate conflicts and anomic structures. For this reason, the cultural and political dimension of the principle of the nation develops a recursive process. On the one hand, political leaders are

dependent on being accepted as a legitimate authority. The legitimacy of political power is dependent on being perceived as a representative of the sovereign. In a world of nation–states, the sovereign is the nation. On the other hand, this enables the emergence of a political agenda to declare the nation as being under threat. Enforcing nationalist sentiments is an option to legitimate claims of power. Reference to the nation can then enfold emotional power, undermining the normative basis of social order. This enables an endogenous explanation to be made of both peace and conflict. The very principle that facilitates social integration also provides the components that allow for its destruction.

ETHNO-NATIONALIST WAR AS EXTREME EVENT

In abstract terms, the relation between legitimacy and power can be described as a recursive function. It is a well-known fact that recursive functions often exhibit strange behaviour. Thus, the hypothesis formulated above suggests viewing the breakdown of the precarious stability of inter-ethnic relations¹⁰ as extreme events from the perspective of systems of self-organised criticality [15]. Examples investigated within the framework of extreme event statistics so far include earthquakes, volcanism [56] and speculative bubbles in financial markets [57]. Although the probability of these events occurring is small, the risks involved are high. Extreme events cannot be treated as statistical outliers because they are not due to chance, but are manifestations of the complexity of the systems [58]. This implies a different statistical model to the traditional ballot box model of classical probability theory. In terms of experimental statistics of the treatment and the control group, the occurrence of extreme events is not a feature of any treatment. This would be an exogenous explanation. In self-organised systems, extreme events are not due to exogenous treatments; they are a feature of the system itself, i.e. the control group.

Complex systems of self-organised criticality exhibit characteristic statistical patterns, such as unpredictable volatilities and power law distributions [58-60]. The power law distribution is the central statistical instrument to describe extreme events. For event classes that follow a power law distribution, it holds that the size of an event is inversely related to its frequency. These statistical patterns enable us to test the hypothesis that ethnic conflicts are extreme events of the self-organisation of the nation-state. Namely, it has to be examined whether such patterns can be detected in the data. Since Richardson's [61, 62] early investigations, it has been established that the distribution of the size of interstate wars follows a power law distribution. In [14] a framework was developed to account for the mechanisms that drive interstate war, leading to a power law distribution of casualties. This refers explicitly to the theory of self-organised criticality. [63] indicate that power law distributions can also be detected in civil wars. It is thus a well-known fact that, on a macro level, many aspects of conflicts can be described by extreme event statistics. This provides evidence that the ordering principle of the nation also enables an integration of large-scale social groups that is only of precarious stability. The recursive relation between cultural and political dynamics provides theoretical evidence that ethno-nationalist conflicts might well be an extreme event generated by the very mechanisms of this ordering principle.

However, the basic population has to be defined in order to undertake a statistical examination. At this point, it has to be borne in mind that the basic population is not restricted to instances of conflicts. The hypothesis that social conflict and social integration are due to the same sources implies that the basic population cannot concentrate on an examination of conflicts. For instance, Richardson's well-known statistics of the size of wars concentrate on wars. Thus it is a statistical examination of a well-defined basic population, namely wars. However, to regard only conflicts is a too narrow definition of the basic population. It must also include cases of no conflict. Yet this raises the question of how to set

the limits of the basic population. It would obviously be incorrect to simply include all states in the basic population. As the example of feudal states illustrates, states do not need to be based on the principle of the nation. The question of defining a basic population is more intricate in the case of this hypothesis since we must determine which cases count as nationalist modes of social integration. Moreover, the time span poses problems: for instance, should Yugoslavia be counted as an instance of successful social integration (which it had been for 40 years), or is it a case of the reverse category?

The problem of defining a basic population can be solved by an experimental setting, using a social simulation framework. First of all, this guarantees that statistical patterns are indeed manifestations of the system simply because they are a result of the mechanisms implemented in the model. Moreover, since a simulation model represents a stationary process, it allows the question to be integrated into the framework of quasi-ergodic processes. [64]. According to the quasi-ergodic hypothesis, the pathway of a trajectory comes arbitrarily close to any point of the phase space. Following this framework, the probability that a critical zone will be reached increases over time. This can be investigated by repeated runs of the *same* simulation model with different parameter settings to investigate possible developmental pathways of the model assumptions. The basic population is then the number of simulation runs. While the simulation runs are stochastically independent, they are nevertheless a result of the same underlying structure. This guarantees that the different simulation runs are different possibilities of the same generating conditions.

This allows for counterfactual thought experiments with what could be denoted as possible histories of the model. In this case, the distribution of the time until the model runs into a conflict mode can be observed (cf. [65]):

- the number of simulation runs generate a sequence X_1, \dots, X_n with a distribution F of the waiting time until a conflict mode is reached. The distribution F can then be examined,
- with $M = \max\{X_1, \dots, X_n\}$ it can then be asked whether the probability p that M is smaller or equal to a certain threshold z holds.

Since the simulation runs are stochastically independent, this can be calculated according to the theoretical conditions to generate a power law distribution. This requires that the single probabilities are independent. This in turn implies that the probabilities are multiplicative and the probability can be calculated as a power law distribution:

$$p(M \leq z) = p(X_1 \leq z) * \dots * p(X_n \leq z) = [F(z)]^n \quad (1)$$

Yet the counterfactual approach does not allow for a conventional post-hoc validation of simulation results by comparing them with real-world data. The research question is directed at the *variability* of simulation results. However, the possible developmental pathways of the model cannot be compared with a set of possible histories of a real-world case. Obviously, only one history exists. In this case, two possible options exist:

- 1) The first option is to rely on a purely theoretical model. A purely theoretical model might have been able to generate correct quantitative statistical patterns on an instrumental level [66]. The guiding principle of the model development is often simplicity, to enable a thorough comprehension of the model dynamics. The most prominent example of such an approach is the KISS principle (Keep It Simple, Stupid). However, such models do not aim to provide a correct description of the generating mechanisms of the target system. This impairs the identification of the causal processes in the target system, and therefore the possibility of intervention.

- 2) The second option is to base empirical validity not on the simulation results, but on the model assumptions. This suggests following the KIDS (Keep It Descriptive, Stupid) [67] principle as a modelling strategy. The KIDS principle recommends not using the principle of simplicity as a starting point for model development. Rather, models should be built on as much evidence of any kind as possible. The single elements provide evidence for the model, because they are taken from an empirical case. This enables experimentation with these model assumptions to rely on the validity of the singular assumptions. For this purpose, the complexity of a historical situation has to be dissected into single ‘atomic’ elements that can be evaluated with regard to their face validity [68]. These ‘atomic’ elements can then be the subject of experimental variation. This enables us to characterise developmental pathways of the real structures of the system by isolating atomic elements and to investigate the model behaviour in the absence or under the variation of these elements. The validity of counterfactual experiments can then rely on the validity of these atomic elements¹¹.
- 3) These experiments can then be used to test the hypothesis: it can be investigated whether the simulation runs with different parameter combinations in fact reveal a power law distribution. This would in turn provide credibility for the hypothesis. The experimental question is then to compare the relative sizes of regions of stability and instability of the developmental pathway of the trajectory [69].

Such an approach requires the selection of a case study. In fact, the series of inter- and intra-state wars in former Yugoslavia provide a well-documented example. This allows for the formulation of model assumptions based on detailed pieces of empirical evidence. These wars culminated along the borderlines of ethnicity and went hand in hand with serious war crimes such as ethnic homogenisation. Located in Southeast Europe, the ‘Balkan Wars’ were fought in a region that historically belongs to the tradition of the European nation-state, the so-called eastern mode of nation building. Thus they provide a clear example of the case under scrutiny. Moreover, in the mid 1980s Yugoslavia was one of the most liberal, well-developed Eastern European states. Even two years before the sudden outbreak of war, it remained unanticipated by foreign policy analysts and the citizens themselves. In the same manner, the later sudden outbreak of violence in Kosovo in 2004 (i.e. a considerable time after the wars) also remained unanticipated. However, extreme events and unpredictable volatility are typical features of complex systems [58, 60]. This bears evidence of the hypothesis that it is an extreme event. This in turn can be explained by the hypothesis that the same mechanisms that in normal cases support social integration can also be detected in the outbreak of ethnic violence. Moreover, the ambiguous and cautious reaction of the international community at the outbreak of the conflicts [70] made clearly visible the internal mechanisms of the escalation process up to a point of no return. For this reason, the wars in former Yugoslavia lend themselves for selection as a case study.

THE MODEL ARCHITECTURE

In the following, an overview of the model architecture will be given, cf. [17]. We will outline how the atomic elements are derived from the evidence of the case. It has to be emphasised that only the processes of the early phases of conflict escalation, and not the entire wars, will be considered. Later stages of wars were increasingly influenced by military considerations. The ‘military logic’ has a momentum that differs from the question under consideration. For the question of whether and how the nation-state can promote social integration and social conflicts (i.e. social disintegration), the early phase is critical. This is the region of the ‘social phase space’ in which the bifurcation to peace or conflict can be found by mobilising the population to engage in war and even to actively commit war crimes.

GENERAL DESIGN

To represent the interaction between the cultural and the political dynamics, the model consists of two types of agents: the political élite and the local population. Politicians are modelled as more complex actors. Local citizens, modelled as simpler actors, exist in greater numbers. However, the two types of actor are structurally coupled. This reflects the recursive feedback between the two kinds of dynamics. On the one hand, politicians' careers are dependent on mass support; on the other hand, the mobilisation of mass support stimulates the mobilisation of individual identities. Thus the driving forces of the model are political career aspirations at the level of the political élite and the mobilisation of ethnic identities at the level of the local population. This reflects the fact that the career of, for instance, Milosevic, was promoted by his ability to stimulate mass demonstrations [21], encouraging a political climate for conflict escalation.

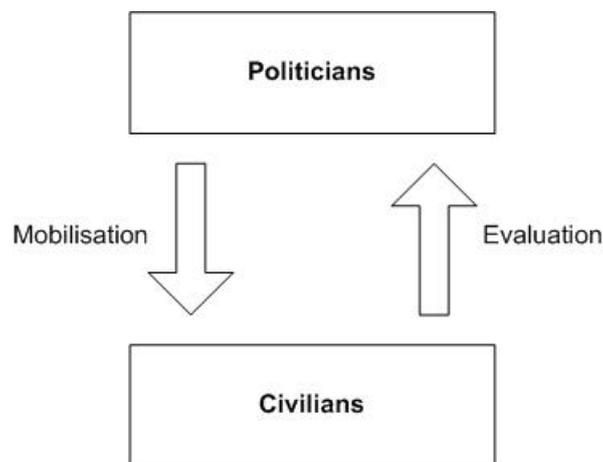


Figure 1. Relation of the two agent types of the model.

ACTOR MODELS

The aim to promote a personal political career can be described as a rational motivation. On the other hand, ethnographic accounts [71] have described the involvement of the local population in war crimes as emotionally driven. To represent the different motivation of citizens and politicians, the two agent classes are modelled using different actor models. Politicians can be represented by the standard model of the rational actor model. Here the theory of subjective expected utilities (SEU), originally developed by [72] can be utilised. The goal of these agents is to make career advancements. However, these career aspirants are in competition with one another. Unsuccessful politicians are replaced by new up-and-coming politicians. In the first instance, these imitate the successful politicians. The criterion of the rivalry is their popularity within the population. Thus, politicians are opportunists who aim to maximise their support. However, the strategic evaluation is undertaken in three dimensions:

- *Political atmosphere*: this is measured by support for a certain type of speech.
- *Credibility*: this is a function of a politician's personal history. A politician is no longer credible if he or she changes the political agenda too frequently.
- *Exclusiveness*: an increasing number of politicians who decide to hold a certain type of speech decrease the chances of an individual politician to be recognised as the prime representative of this agenda. It may be advantageous to opt for a type of agenda with fewer competitors, even if there is less overall support.

The emotional motivation of the population can be represented following the theory of the ‘identity preserver’, popularised by [73]. This actor model can be illustrated by a scale with two containers representing two different value orientations (Fig. 2) [74]. Civil values can roughly be described as an orientation on the idea of Yugoslavism (‘unity and brotherhood’) [75]. However, at the time of conflict escalation, issues of political and economic reforms were an urgent topic of public debate. This is also covered by the heading ‘civil values’. On the other hand, the value of ethnic identity represents the pride of the nation and the meaningfulness ascribed to this issue. Opinion polls indicate that roughly 10 % to 15 % of the population regarded this as a prime issue [2]. In principle, however, individuals possess both types of value orientation. However, the strength of the respective value orientation may differ. This is represented by the amount to which each container is filled, as illustrated in Fig. 2.

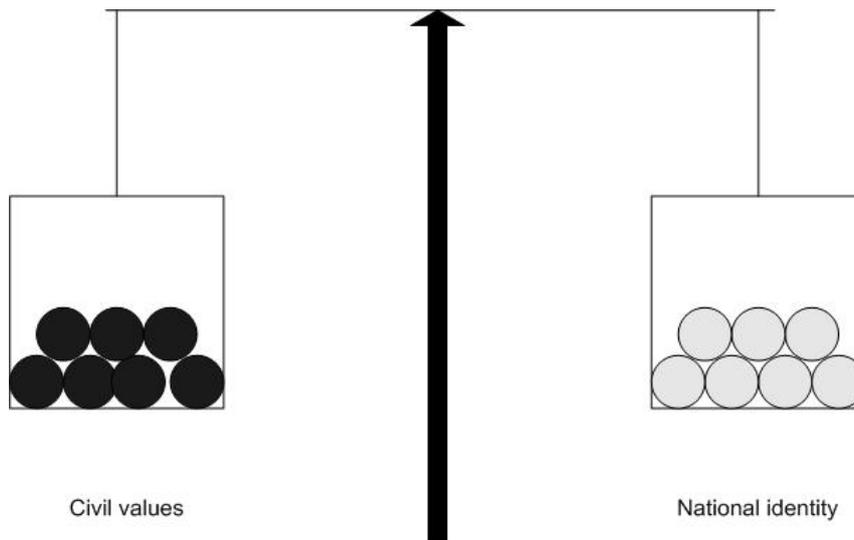


Figure 2. Actor model of civilians.

SCHEDULING

The overview in Fig. 3 highlights the fact that the model scheduling consists of two phases: a state of social order and an anomic state. In principle, the recursive feedback loop between politicians and citizens indicated by the two upward and downward bars may be maintained in the state of social order. This is a rather general mechanism, not specific to the Yugoslavian case. However, under certain circumstances (in which, again, both levels of politicians and citizens are involved) the model may enter the anomic state. The concrete mechanisms for the transition into the anomic state are specific for the Yugoslavian case. Following the KIDS principle, they are derived from the circumstances of the first time ethnic homogenisations took place in the conflict surrounding Krajina Serbs, described in Section 2. In the following, the individual steps will be explained in more detail.

1st step: political mobilization

Politicians hold speeches to organise support. These speeches can appeal to either civil values or the national identity of the respective nation. Six different nations existed in Yugoslavia. In the first round the type of speech is selected randomly. People all over simulated ‘Yugoslavia’ are able to hear the speeches. One example would be that the speeches are broadcast on television news. Viewers can evaluate the speeches according to their own political conviction, modelled in the actor model described above. Initially, the convictions

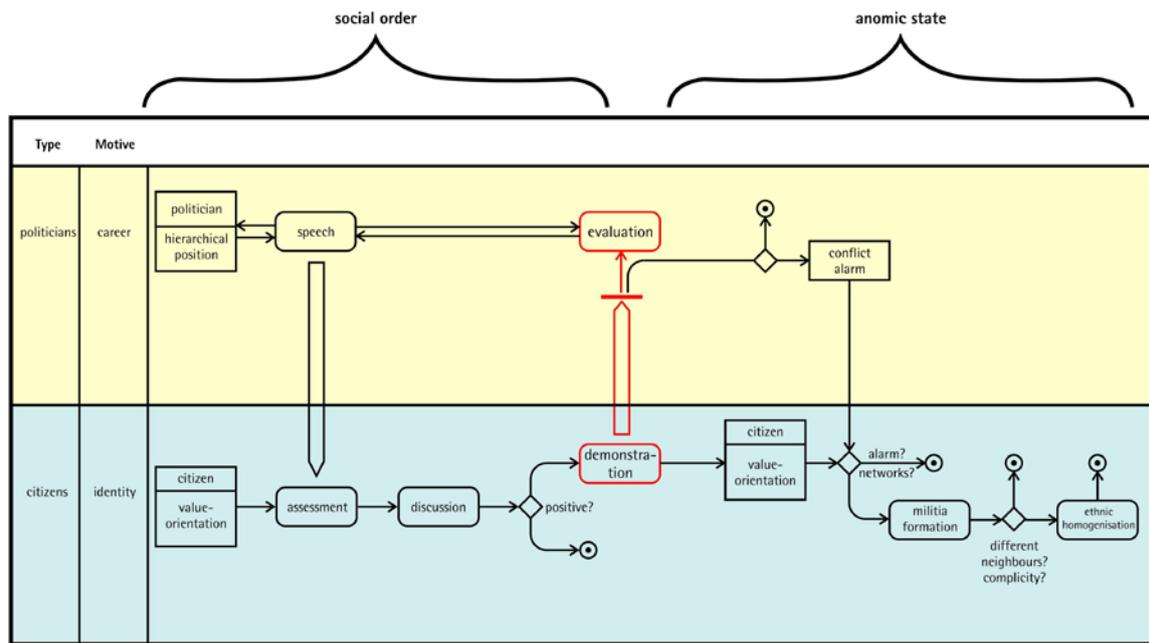


Figure 3. Overview of the Scheduling.

are randomly distributed. The evaluation is undertaken by calculating the distance of the type of speech from their conviction.

However, people are not isolated, but live in neighbourhoods and have networks of friends. People discuss their evaluation of the speeches in these networks. This represents the idea that the success of political campaigns becomes the topic of public debate, causing people to decide whether or not to support the speeches. Support is signalled by participating in demonstrations in favour of the politician. The decision can be based on two grounds: first, individuals can strongly support the speech, regardless of their friends' opinions. This is the case when the distance between their conviction and the speech is rather low. In this case, they participate in the demonstration alone. Second, after the discussion people can decide to join a demonstration as part of a group. In this case, the majority of the group moderately favours the speech, i.e. the average distance is considerable, but on the positive axis. Participating in these demonstrations enforces value preferences. This represents the fact that, in particular at the beginning of the conflicts, Yugoslavia faced a series of huge mass demonstrations. A prime example to illustrate this basic idea is Milosevic's well-known speech in Kosovo, in which he addressed the Serbs living in this region, stating that nobody should beat them. This speech, delivered at a mass demonstration, was broadcast on the news, and stimulated reactions all over Yugoslavia. The last point is important insofar as a speech does not only have a regional effect. It enabled Milosevic to become well known throughout Yugoslavia. It was the take-off of his career. However, while he became popular among a certain subpopulation of the Serbian people, he became the subject of fear and anger in the other Yugoslavian nations.

2nd step: political conflicts – securitization

In the second round, politicians evaluate which type of speech they should hold. Speeches are no longer selected randomly. This reflects the opportunism observed in the number of

politicians who changed from a communist to a nationalist agenda. It is crucial for the particular case of Yugoslavia that the agenda of politicians is recognisable across the Federal Republic. Moreover, people of different nationalities lived in different republics. Thus, an appeal to a certain type of nationalism is recognisable also by people living outside that particular republic. For instance, Milosevic's appeal to Serbian nationalism ('nobody should beat you') was recognised by people of all nationalities in all of the republics, and therefore also by Serbs resident outside Serbia. This had the effect that the Serbian politician Milosevic was regarded as their representative by a group of people living outside Serbia, namely the 'Krajina Serbs' living in Croatia. This was a cause of political conflict. To abstract from this particular case, in the model an alarm function for the rise of a political conflict is activated if a nationalist politician gains support outside the territory of his or her home republic (Fig. 4).

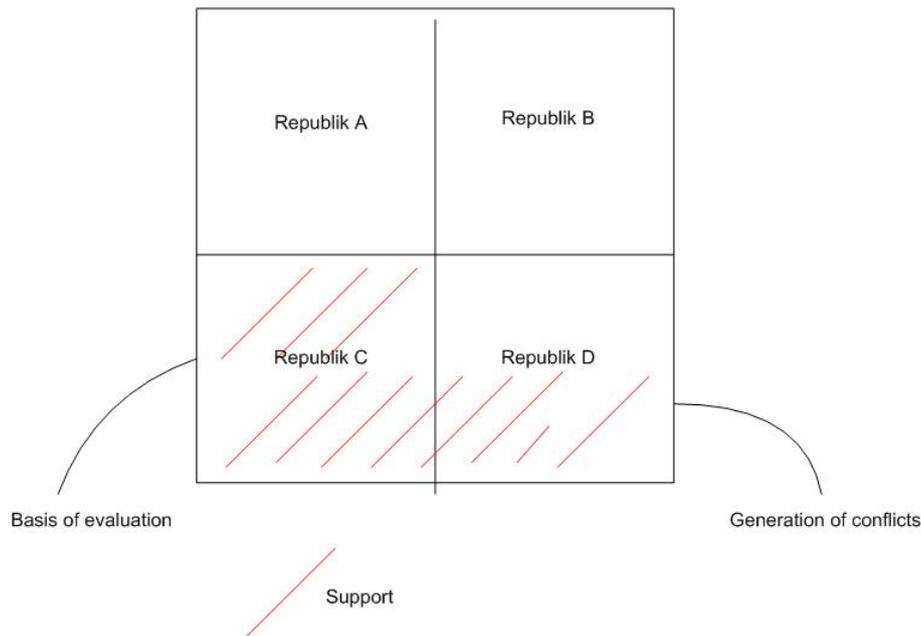


Figure 4. Generation of political conflicts.

3rd step: conditions for violence

Now the conditions for violent conflict escalation are given. Three conditions can be derived from the empirical case:

- *Opportunities:* These are given by political conflicts, providing an atmosphere in which, for instance, violence may no longer be subject to criminal prosecution.
- *Motivation:* Nevertheless, individuals must become motivated to *undertake* violence. It is striking that ethnic violence was barely undertaken by individuals. Instead, paramilitary militia played a crucial role. However, at least at the onset of the conflicts, these were rather locally organised [76]. While not only the direct neighbours of the particular villages were involved, they were nevertheless regional organisations that did not have the logistics required to be represented across Yugoslavia. This is modelled as networks of highly radicalised nationalists. Thus, the degree of mobilisation of ethnic identity has to be very high, while the degree of civil values has to be very low. This represents the emotional motivation of civilians involved in the war¹². Such individuals have to become connected to jointly form a militia. They search for other agents with such a characteristic. However, the search radius is limited, and they act within the limits of their search radius.

- *Complicity*: It is curious that a further condition was a constant characteristic of the ethnic homogenisations in former Yugoslavia, namely, a certain degree of complicity by the local population [19, 76]. Again and again, the militia planning to attack a certain village warned the inhabitants of their ‘own’ nationality. These could have warned their neighbours of different nationality, but they chose not to. They often even participated in the looting that took place after the attack. This behaviour pattern is modelled as an agent with an eventually only modest degree of ethnic mobilisation, but also only a modest degree of mobilisation of civil values.

4th step: anomic system state

If these conditions are fulfilled, the model reaches the anomic state. The militia undertake ethnic homogenisations within its local neighbourhood, including murder and displacement. Survivors flee in the direction of the territory of their ethnicity. The refugee population provides a source of sometimes strongly radicalised nationalists; if these find collaborators, they accompany a militia. However, it has to be emphasised that the specific actions and tactics of certain militia are not the focus of this investigation. Instead, the guiding question is whether and how such an anomic system state can be reached in the first place.

CONCLUSION AND OUTLOOK

Although the wars in former Yugoslavia have been studied extensively, how the extreme outbreak of violence was possible remains a controversial question. The manipulation hypothesis claims it has to be traced back to Machiavellian politics. This builds on the evidence that ethnic relations were described as unproblematic, even at the time of already emerging political conflicts, and the ‘national question’ was perceived as urgent by only a small minority. In fact, politicians used nationalist rhetoric as a device to gain access to power. On the other hand, the ancient hatred hypothesis builds on the evidence that violence was undertaken deliberately by civilians. This is then traced back to the numerous wars between the Yugoslavian nations stored in the collective memory.

Explanations of these wars typically introduce certain factors that differ from the situation of peace. For instance, these may be economic shocks or the appearance of certain politicians. This can be characterised as an exogenous explanation. However, civilisations are continuously faced with the problem of integrating large-scale social groups. The nation-state has established an ordering principle that is an essential element to solve this problem. Yet, it can be suspected that such an ordering principle will tend towards a stable equilibrium. Evidence from interstate wars indicate that international relations are a system of self-organised criticality. A theoretical examination of how the organising principle of the nation may generate social integration suggests that this ordering principle also develops a system of self-organised criticality. This implies that social order may revert to an anomic state. This was observed, for instance, in former Yugoslavia. This is an endogenous explanation of ethno-nationalist violence, as a manifestation of the complexity of the system. This can be tested by the simulation framework developed here: politicians indeed have the capacity to provoke nationalist (as well as civil) sentiment. This reflects the intuition of the manipulation hypothesis. However, they are not an exogenous ‘shock’, but are generated endogenously in the model. People select their politicians. Their political agenda is not arbitrary but – at least indirectly – a reflection of the political atmosphere amongst the population. Thus, if nationalist extremists come to power, this is not arbitrary. This reflects the intuition of the culturalist explanations. However, in contrast to the ancient hatred hypothesis, the political atmosphere is not simply inevitably given since ancient times, but evolves endogenously in the model. People are not condemned to violence. However, the recursive feedback relation can generate only precarious stability.

The fact that the Yugoslavian case is well documented suggests its use as proof of the concept. However, the idea of the nation is of a much wider scope. It is misleading to presume that such violence may only happen on the Balkans. Conflicts involving an ethnic dimension are observed all over the world. Presumably, not all of these conflicts involve a political dimension comparable to this case. [6, 77] provides detailed evidence of instances that may be explained purely on a cultural level. However, a number of these conflicts do involve a political dimension. It can be presumed that these cases exhibit a recursive feedback relation between cultural and political dynamics, as described here. For instance, the number of partly ‘frozen’ ethno-nationalist conflicts in the post-Soviet area may well be driven by comparable dynamics. While the specific mechanisms that drive the model from the state of social order into an anomic state are derived from detailed evidence from the empirical case, the mechanisms that generate the feedback loop between the political and cultural level are rather general (Fig. 3). For instance, the emergence of nationalist political parties can be observed across the European Union. This may well be an instance of such a feedback loop. While the details of the mechanisms of the transition to the anomic state cannot be generalised to this case, its possibility may provide awareness of the fragility of stability. There may then be hope that the study of the past violence in Yugoslavia will help to prevent future disasters. A simulation study enables us to detect escalation paths and stable pathways, and eventually early warning signals. A systemic view shows at least that we humans are not condemned to violence. At first sight, this might be counterintuitive. However, while self-organised criticality suggests that retaining civil life is critical, the criticality also shows that it is open to the freedom of human will.

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REMARKS

¹A minor example is that the republics that left the Yugoslavian Federation were armed to a large extent by labour migrants [21].

²In the economic literature, this is typically referred to as ‘shocks’. For a discussion of endogenous versus exogenous origins of economic crises, compare [78]. However, an endogenous explanation by no means implies rejecting the explanations identified in the literature. On the contrary, it needs to be explained how they can be integrated by showing how they are generated by the operational principles of the nation-state.

³Milosevic went on to win three consecutive elections in Serbia.

⁴However, the first victims of the war were found in Belgrade: the Serbian media reported untruthfully that peaceful, helpless Serbs had been murdered by Croats. When the lie was exposed, mass demonstrations were held in protest of Milosevic. In the course of the conflict, a policeman and a demonstrator died.

⁵For instance, while the most divergent economic conditions were between Slovenia and the Kosovo region, the most extreme violence took place within the republic of Bosnia-Herzegovina.

⁶Further conditions have been identified in geographic circumstances [5]. Yet, recourse to constant (and indeed: endogenous) geographical factors cannot explain peace, i.e. why – in this case – Yugoslavia was a functioning state for 40 years.

⁷Most prominently advocated by [79].

⁸Obviously not in other dimensions: most of all, the nation is a secular institution and thus cannot provide eternal salvation [34].

⁹Within the framework of theories of ethnic conflicts, this account is usually characterised as belonging to the constructivist camp. However, it also has an instrumentalist aspect, as it emphasises – eventually instrumentalist – political action. The most prominent antithetic account is the primordialist theory of [77].

¹⁰So far, the theory of extreme events has not been applied to mass-mobilization in times structural ruptures of social structure. Empirical research suggests that it is an extreme event [80, 81]. However, so far it has not been inquired empirically whether the time scales of the occurrence of such events can be modelled by extreme event statistics.

¹¹Such an experimental approach is closely related to Ragin's re-evaluation of social inquiry [82] and was already suggested by Max Weber's study of historical causality [68].

¹²In fact, a number of criminals, such as the 'Arkan tigers' were actually also involved in war crimes. Criminal motivation is not represented here.

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MODELIRANJE DINAMIKE SEKURITIZACIJE NACIONALNIH IDENTITETA

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SAŽETAK

Na primjeru eskalacije sukoba u bivšoj Jugoslaviji, u ovom radu razvijen je zajednički okvir za mehanizme koji dovode do eskalacije sukoba. Eskalacija etno-nacionalističkog nasilja opisana je kao endogena značajka naroda. Princip naroda može postati organizirajući princip za integraciju velikih društvenih grupa. Međutim, on također može generirati ekstremne događaje etno-nacionalističkog nasilja. Opisana je arhitektura simulacijskog modela kojim se provjerava hipoteza ekstremnih događaja.

KLJUČNE RIJEČI

Jugoslavija, eskalacija sukoba, sekuritizacija, ekstremni događaji, nacionalizam

PROPAGATION OF NONLINEAR PHENOMENA IN A MEASUREMENT SEQUENCE

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ABSTRACT

Measurements provide one with results, in the form of both quantitative estimates of measured quantity along with attributed quantitative probabilistic analysis. Measurement is prescribed precisely in order to enable researchers, experts or other measurers to obtain maximum confidence in its results. In that way, the probability of obtaining unpredicted or unwanted consequences is minimised. Yet, owing to a rather large number of degrees of freedom in a typical measurement sequence, its nonlinear character and nonlinear couplings, in general it is not known in what amount a variation in measurement conditions brings about significantly larger variations in measured quantities or its derivatives.

In this article we treat in some details the aforementioned influence of variations and argue about possible results. In order to illustrate the treated influences we present results of a rather simple and common measurement of surface roughness of solid state objects. It is argued that there is no significant augmentation of variations in results of initial measurements throughout measurement sequence.

KEY WORDS

nonlinearity, measurement, complexity, roughness

CLASSIFICATION

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INTRODUCTION

Measurement, one of the cornerstones of modern science and technology, is a process conducted in a prescribed way. Prescriptions have been developed organically, during centuries of development. The purpose of prescriptions is to reduce the complexity and complicatedness of environment in which a measurement system is formed, i.e. measurement takes place. The reduction is of twofold character: (i) number of degrees of freedom of the environment, which influences final result, is minimised and (ii) quantitative estimate of residual penetrated environment complexity is relatively small.

In that way a measurement sequence¹ forms a part of the complement to complex systems. Complex systems are rather broad set of systems showing extremely large consequences of induced minute changes in its structure and/or dynamics [1]. That is in most cases traced back to existing nonlinear couplings among elements, i.e. the subsets of a complex system.

While on the one hand measurement sequence and complex systems share some similarities, their substantial difference is in the range of variation of the end result caused by minute changes in the environment, or intra-system variables.

In this article, we analyse in detail that topic. In particular, we start from the generic model of a measurement sequence and relate its element and their relations with elements and relation which one would encounter in a complex system. We apply that analysis onto a particular experiment with accompanied measurements having direct and significant practical importance.

Corresponding, generic model of a measurement sequence is developed in the second section. Reduced version of that generic model is formed in order to measure surface roughness, and its results are presented and analysed in the third section. Fourth section contains summary, conclusions and projections of further work.

GENERIC MODEL OF A MEASUREMENT SEQUENCE

Result of measurement is a set of values of a quantity attributed to a measured quantity, together with any other available relevant information [2]. A measurement result is generally expressed as a single measured quantity with a measurement uncertainty. If the measurement uncertainty is considered to be negligible for some purpose, the measurement result may be expressed as a single measured quantity value. In many fields, this is the common way of expressing a measurement result. However simple the definition may seem, it implies a thoroughly developed and structured context, which is nowadays covered by legislated industry standards or bodies having jurisdiction.

In particular, any referent quantity is established on the basis of consensus of a scientific community, following a large number of conducted experiments with unanimous interpretations. Along with thereby gathered experience, a referent quantity implies the existence of measuring equipment, Figure 1. Last but not least, referent quantity implies the development of scientific and technical thought which enabled all underlying activities and which requires the establishment of a referent quantity. In that way, a simple definition of a measurement implies interrelatedness of scientific, technical and social moments.

Emphasised relations among elements of a measurement sequence as shown in Figure 1 are in general of diverse amount, duration and sensitivity to variations. Furthermore, relations shown are only direct relations. Other, let us call them, indirect relations would in fact include all possible combinations of relations among listed elements. As an example, analysis & interpretation can bring conditions that influence, or change the very procedures, or

measured quantity or equipment. Naturally, in order to understand whole set of relations, one needs to understand their implications and, in more general way, their meaning from the point of view of the environment to which measuring sequence belongs

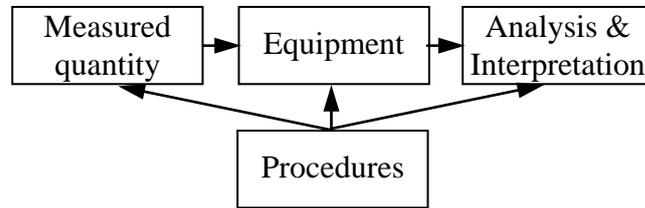


Figure 1. Measurement sequence starts from a procedure which prescribes choosing and preparation of measuring equipment, as well as of a body or process carrying measured quantity and subsequent analysis and reporting of results.

In a larger system, measurement sequence is part serving as a source of reliable information about (quantitatively expressed) conditions of some emphasised part. In that sense, results of measurement sequence should be stable, and if possible linearly dependent on variations in initial or boundary conditions. Overall, variations in measurement sequence should not induce augmentation of variations' consequence in a larger system which exploits measurement results, or occurrence of emergence as a limiting case of augmentation.

Encountered notions of emergence and augmentation of initial variation are regularly utilised in the context of complex systems. Complex systems are systems consisting of nonlinear coupled elements which are characterised by significant sensitivity to small variations. In other words, they show augmentation of variations' consequences and emergent phenomena as its limiting form. It is interesting to note, while substantial to utilise and non-trivial to analyse that measurement sequence as a part of a larger, complex system should have suppressed essential characteristics of a complex system. Preliminary analysis of diverse measurement sequences reveals that, in each and every case, the suppression was achieved in a different manner, based on a detailed understanding of all important elements.

CASE STUDY: MEASUREMENT OF SURFACE ROUGHNESS

Surface roughness is the property of surface of any solid state object, which is of importance for predicting and optimising exploitation of that object. Surface roughness includes several quantitative parameters, which are all representations of a surface roughness profile [3]. Surface roughness profile² is a height of a particular point on a surface, measured orthogonally from surface determined as the averaged tangential surface. It can be positive or negative number.

Two of the parameters expressing quantitatively surface roughness profile are the following³: arithmetic average of the absolute values of surface's heights Ra and maximal vertical distance between any two surface points Rz . They both belong to the peak & valley group of parameters. They are determined for a 2D profile of a surface and are in recent years broadened to 3D S-parameters, determined for a scan of part of a surface. However, since R-parameters are in use for a much longer time than S-parameters their use in the context of this article is more appropriate. Nevertheless, similar analysis can be performed with S-parameters. We skip details of sampling of surface in order to obtain representative values of R-parameters.

Let us consider as a particular example of measuring surface roughness parameters the case in which a portion of a metal object's surface should be covered with a protective layer of

dye [4]. Quantity of the dye which is needed has twofold economic consequences. On the one hand, the thicker the layer of dye coverage, the higher the cost of surface's protection. On the other hand, the thinner the layer of dye coverage, the higher the probability of surface's corrosion.

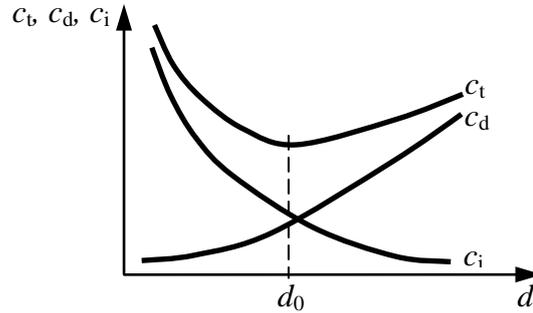


Figure 2. Qualitative representation of total (c_t), direct (c_d) and indirect (c_i) costs related to anti-corrosion protection of a surface, shown as a function of average thickness d of dye covering surface.

Since corrosion means degradation of the surface, its occurrence implies both insufficient thickness of dye coverage and also, relatively large costs for surface protection with added costs of degraded surface's repair. Let us call costs of dye and its covering as the *direct costs*. Then, let us call the *indirect costs* all costs occurring during corroded surface repair. Total costs of surface related processes are added direct and indirect costs. Qualitatively, situation is presented in Figure 2. Based on the previous considerations, one may introduce the function $c_t(d)$. In an optimization problem, its minima will bring about the thickness of dye coverage which minimises total costs related to surface coverage d_0 .

However, thickness d is an averaged quantity. Because of the nonzero surface roughness, on some surface position with coordinates (x, y) the position-dependent thickness $d(x, y)$ will vary. That is implicitly included in the Figure 2 and accompanied considerations. Owing to some realistic distribution surface roughness profile, for a given d , in general there will be parts on the surface with uncovered surface⁴. Indirect costs c_i are nonzero for larger d precisely because some parts of the surface are still left uncovered. Let us denote with A total area of all parts of the surface which are left uncovered after the surface is covered with the dye of average thickness d . Then $A = A(d)$, which can be inverted to $d = d(A)$ and consequently $c_t = c_t(A)$. Function $d = d(A/S)$ is the usual Abbott-Firestone function for quantity of material on a surface [5].

Let us denote with z the surface height of a surface profile measured from some referent point. If the probability distribution function of surface height z is $p(z)$, then one has

$$A = S \int_{-\infty}^d p(z) dz, \quad (1)$$

where S is the total surface area. Since z is the surface height of a surface profile measured from some referent point, it will always be finite, so lower integration point in (1) can be equivalently stated as some finite, otherwise arbitrary, quantity z_{\min} .

In case of rather randomly roughened surface, probability density function is the normal distribution $\mathbf{N}(\mu, \sigma^2)$ of expected value μ and standard deviation σ :

$$p(z) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left[-\frac{(z - \mu)^2}{2\sigma^2}\right]. \quad (2)$$

In (2), precise values of μ and σ are to be found numerically from experimentally obtained surface roughness profiles, such as the one given in Fig. 3. Substitution of (2) into (1) brings about the following expression [6]:

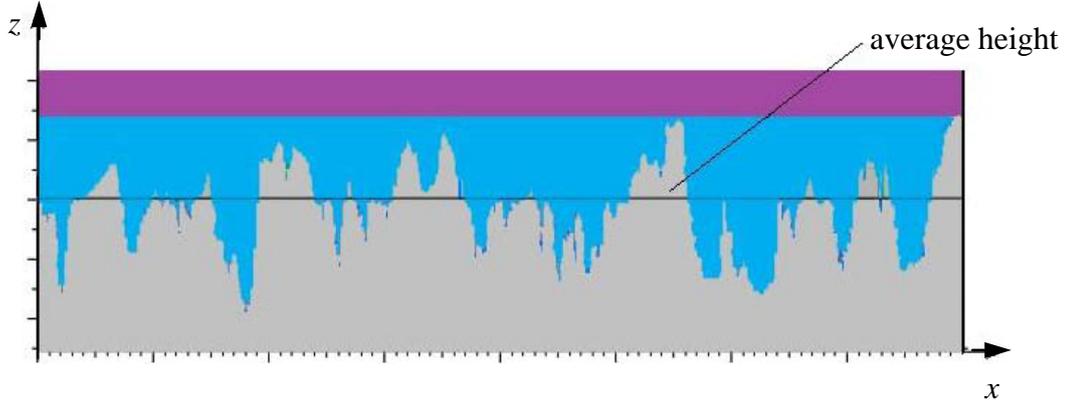


Figure 3. Typical example of surface roughness profile (grey) and dye coverage (blue and violet) [4]. Referent line form measuring surface heights is not shown for simplicity. Profile is obtained after scanning with stylus on some linear, otherwise arbitrary axis x .

$$A = \frac{S}{2} \left[1 + \operatorname{erf} \left(\frac{d + \mu}{\sigma \sqrt{2}} \right) \right], \quad (3)$$

so accompanied Abbott-Firestone function is:

$$d = \sigma \sqrt{2} \left[\operatorname{erf}^{-1} \left(2 \frac{A}{S} \right) - 1 \right] - \mu. \quad (4)$$

In deriving (3), the assumption $d + \mu > 0$ were used. Otherwise, instead of (3) one obtains a form including Heaviside function, which we consider being not of a minor correction since practically important range of values has $d + \mu > 0$. For semi-qualitative considerations, and based on Figure 2, dependence of total costs on average thickness of dye coverage d can be modelled as

$$c_t = K \cdot \exp(-\alpha d) + \beta d. \quad (5)$$

Interpretation of constants in (5) is that K is the total cost of substitution of corroded surface with new one, while α and β are parameters denoting the dimensional equivalent of corrosion influence and rise of direct costs for a unit change of thickness, respectively. Implicit assumption in (5) is that area of the total surface S is relatively large so that some constant contribution to direct cost is negligible in the range of interesting thicknesses d .

In cases in which protective function of dye coverage is crucial, accompanied parameter α is relatively small, in the sense that minimum of total costs is shifted toward relatively larger values of d . However, in that range, shape of (4) shows relatively smooth growth for a decrease of A/S , which is faster than shift of d as described by (4). In that sense, one does not expect deviating dependence of any of the quantities c_t , d_0 or A/S onto one another, and similar considerations point to the fact that it is also valid for small variations in any of these parameters. Thus, analysed measurement, profiling of surface roughness using R-parameters, does not show some instabilities or significant augmentation of variation in initial parameters.

Similar analysis can be performed for S-parameters, and using numerical approach for any type of surface roughness profile, what would add to test of wide applicability of stated suppression of nonlinearity's propagation in that segment of measurements.

CONCLUSIONS

Measurement sequence has some elements of complex systems. In order to be useful, the measurement sequence should suppress nonlinear augmentation of variations in some of its elements onto final results and/or its derivatives. In the case of surface roughness profiling, on the semi-quantitative basis it is argued that such augmentation does not exist.

REMARKS

¹In this article we utilise the notion measurement sequence for a subsystem belonging to conduction of a measurement of some quantity. We purposefully do not utilise the notion measurement system, as it is in general reserved for the totality of measured quantities, the examples of which are SI, CGS, MKS and other measurement systems.

²To be differentiated from surface primary profile and surface waviness profile.

³We denote R-parameters following the current valid standard. In older literature, based on previously valid standards, these parameters would be denoted with subscripts: R_a and R_z .

⁴Because of adhesion, initially the whole surface will be covered with dye, independently of the average thickness of coverage. However, afterwards coverage above and around the peaks in surface roughness profile will be degraded more rapidly, thus the probability that their coverage disappears is rather large. That eventual state is considered here.

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PROPAGACIJA NELINEARNIH POJAVA U MJERNOM NIZU

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KLJUČNE RIJEČI

nelinearnost, mjerenje, kompleksnost, hrapavost

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