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Deterministic chaos theory and forecasting in Social Sciences. Contribution to the discussion

Abstract: Forecasting social phenomena may be hampered in many ways. This is because in nature of these phenomena lies strong and multilateral connection with other social phenomena; but not only – also physical and biological (natural) ones. The content of this publication constitutes presentation of chosen problems of forecasting in social sciences. The attention in the article was focused among others on deterministic chaos theory, on the attempt of its implementation to phenomena from the scope (or from borderline) of social sciences: economy, logistics, science about safety etc. Moreover, one of the threads of ponderation was the attempt to consider whether it's possible to create so-called final theory. The aim of the publication is to signalize possibilities of taking advantage of seemingly exotic for "political scientists" methodology of modeling and explaining phenomena, having its source in exact sciences (in chaos theory) to study social phenomena and processes.

Key words: forecasting, social sciences, deterministic chaos theory, catastrophe theory, bifurcation

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Desire to see future appearances and search potential chances constantly accompanies private and professional human's activity. To satisfy these needs, people still try to elaborate efficient methods of studying future, to prepare themselves for unknown future in a best way (Borodako, 2009, p. 7).

Forecasting is associated with forms of programming, planning the future where the determinants of a phenomenon can be analysed quantitatively, for example, in economics, statistics, and demographics, and testability is expected to be relatively high. For many advocates of purely scientific recognition of the future, especially until the nineties of the twentieth century, forecasts, and therefore scientific prediction with a high degree of testability, can gain academic credit, and the rest of the predictions are to them only a trip to the future in a vehicle driven by wild fantasy. They admit, however, that forecastology is to serve to improve methods of planning and management, which indirectly means challenging other forms of prediction, especially in politics, culture, and politics, where the necessity for predictions is beyond obvious. Sometimes scientific authorities tend to remain completely convinced of it, and so Weber argued that any forms of prediction in the social sciences were impossible, by what he indirectly suggested that we should not create any projects of tomorrow or design ourselves in tomorrow, which in turn questioned the legitimacy of taking account of hope, fears, and dreams (Sepkowski, 2005, p. 65; Donaj, 2013b, p. 7).

One of the tasks set to forecasting as a science, is fulfillment of its practical function, which, among others, draws upon determining a level of forecast's credibility. The level is inherited after laws deductively derived from statistical laws, referring to particular

facts. Credibility’s components in this inheriting is level of certainty of truthfulness and content of casual, co-existential and static laws (Kukułka, 2000, pp. 252–253).[1]

Forecast proceeding must begin with diagnosis of past situation (ibidem, p. 253). The diagnosis should be developed enough to determine existing phase of its fluidity and estimated consequence of future phases. Scientific forecast of practical function needs developmental diagnosis, also called prognostic diagnosis. It consists in investigation of future development of process or phenomenon that is taken into consideration on the grounds of heretofore phases of piecemeal diagnosis (typological, genetic, of meaning and phase) and their arrangements. Prognostic diagnosis involves both result and complement by concluding mainly from hidden developmental tendencies, and sometimes also on the basis of known causal laws (extrapolation). In both cases it’s probabilistic understanding, which leads to uncertain hypothesizes. Since even hidden development tendencies are conditioned by specific situation of studied phenomenon or process, and especially by suitable regulations and disruptions occurring, what in the international relations – just like in every other kind of social relations – play a big role (ibidem, p. 253; Donaj, 2017b, pp. 69–79).

A fair problem for researchers from the field of social sciences is not only the fact, that rapid increase of knowledge proceeds and they cannot take the control over the flood of facts and different information. The fact that many situations, phenomena and processes are hard to distinguish and analyze, constitutes a bigger problem. It stems from their great complexity, inability to deduct all-encompassing picture of given phenomenon or process on a basis of only several “scraps” or parts’ analysis and their desultoriness (Gwiazda, 2011, p. 167).

Forecasting is understood as projection based on specific, inspiring trust data. Prognostics in turn, is a science of projecting future. The aim of scientific forecasting is a possibility to show visions (models) of future in the most probable course of studied phenomenon, with compliance to its directions and dynamics of its development. In hand of forecasting we stream for determination of conditions, in which evolution of analyzed phenomenon would be possible. While drawing up a forecast with this aim, some dependencies and types should be consulted, as well as intensity of external influence and expected internal changes in hand of a phenomenon’s development, what is the subject of the research (Stryjski, 2003, p. 1).

As K. Stryjski fairly notices, forecasting social phenomena is frequently hindered in many respects. It results from the fact, that in the nature of these phenomena is stuck strong and multilateral connection with other social phenomena; and not only – also with physical and biological ones. Hence making judgements about future course of social phenomena, which by contrast to physical phenomena, based on “potent” rights, depend on a great number of factors with different level of stability, is a complex task. Besides, there should be added a fact, that in every social phenomenon a possibility to conduct

[1] Sience should be understood as group of activities leading to gathering resource of suitably circumstancated knowledge about realty (science in pragmatic sense) or as group of statements obtained this way (science in apragmatic sense). See also further: A. Redelbach (1996), *Wstęp do prawoznawstwa*, Poznań; L. Wolpert (1996), *Nienaturalna natura nauki*, Gdańsk; Stryjski K. J. (2004), *Prognozowanie i symulacje międzynarodowe*, Łódź; Guzik B., Appenzeller D., Jurek W. (2004), *Prognozowanie i symulacje. Wybrane zagadnienia*, Poznań.

experiments comes relatively rarely. All of this makes a weaker basis for forecasting future social phenomena course – well in this case a prognosis itself constitutes a social phenomenon, that – connected with other ones – may influence forecasting in many ways (Stryjski, 2004, pp. 30–31).

In the context of above information, it has to be underlined that forecasting social phenomena (in global sense) hinders (limits) among others:

1) *Qualitative character of social science laws* (formulated at a high degree of generality);
2) *Oedipus effect* – predicting triggers action that accelerates the predicted effect;
3) *Syndromatic nature of social phenomena* – phenomena that we study occur in certain wholes, often heterogeneous. Man and his behaviour as the object of study is a bio-psycho-socio-cultural being, so his behaviour is guided by genes, brain, and education (culture). The premise of predictions have to be laws of different nature such as anthropology, psychology, sociology, and philosophy;
4) *Evolving nature of social reality* – the reality we live in is changing radically. The demands of history require that new general knowledge be complemented by new information about new epochs. Therefore, general knowledge has little relevance, in itself it must be saturated with new information. Consequently, in order to continue to predict, new concrete historical knowledge must be taken into account (Materials, Karwat, 2009, pp. 175–188).

As indicated by Sarjusz-Wolski, the mechanism to predict the future is to know and match past events, relevant to the object of forecasting, and the regularities between them (type and strength of the cause and effect relationships), and to draw conclusions about the occurrence (or nonoccurence) of particular future events. The mechanism of prediction can be illustrated by the following simple example. Let us say that we have reached a deep wide river and want to cross it dry-shod, but there is no bridge. We know, however, that a boat would allow us to do it (regularity: if boat, then boating on the water). By serendipity, we have just discovered one in the nearby bushes (cognition of reality). Based on these premises, we can already predict that soon we should be on the other side. However, if our information about the boat was not complete, that is, if, for example, we did not know that it was leaking and taking on water, most likely our predictions would prove incorrect. As a result, we would “end up” somewhere else than expected (Sarjusz-Wolski, 2005b, p. 54). Predicting social phenomena or their development shows (see evolving nature of social reality) that the problem is not only the boat. The problem is also that we do not know if the opposite bank of the river exists (Donaj, 2012, pp. 26–29).

A. Sepkowski indicates that few experts in forecasting would bow to Lech Zacher, for whom it is necessary to take account of irrational and accidental elements, catastrophes, accidents, failure to perceive linearity, continuity of phenomena, and processes in time, because this is one of the most serious barriers to the exploration of the future. According to the theorist, this is not easy, but we can manage, using chaos theory, catastrophe theory, or fuzzy logic, which definitely requires interdisciplinary studies and close co-operation between specialists, on an assumption of openness to other sciences (Sepkowski, 2005, p. 67; Donaj, 2012, pp. 26–29).

Forecastology is also an attempt to find regularities, recognition of development principles. The recognition of development principles – especially development principles

of international relations – creates a basis of knowledge system in this area of social relations. Principles constitute a necessary premise of righteous explaining and understanding these relations, as they facilitate organizing information about international reality and concluding about its variability. These conclusions serve theoreticians and practitioners to explain active and reactive mutual influence of international relations’ participants. They also help to explain processes of these relations taking place in the past, presence or in the future (Kukułka, 2000, p. 248; *Анализ, прогноз*, pp. 41–52).

It is especially precious when we try to find regularities appearing in a form of periodic happenings or processes (e.g. for part of scientists it’s war, for another ones – economic phenomena, like crises etc.). As if they really occur according to some kind of algorithm, it would be easier to foresee, when they will happen (and if they have to happen) (Sawin, Gałganek, 1992; Modelski, 1987). Obviously an open question stays whether our forecast considering the algorithms are righteous (Donaj, 2014, pp. 133–141).

Therefore it seems that systems like “international relations,” “global economy” are schemes that are organized, but in very complicated and unpredictable way. This kind of schemes are handled by *Chaos theory* which – as it could appear – is more connected to science than humanities. Chaos theory studies so-called *deterministic chaos*, so the one that still applies casual laws. However, it’s all about so complicated systems, that they cannot be thoroughly described. Firstly – in local sense it may work in unpredictable way. But secondly – in this unpredictability, an order of higher level may be seen. For M. Tempczyk chaos theory may be an explanation for processes taking place in people’s world: an order born from chaos is even market. Everyone establish their business energetically, at random, but there appear some tendencies, an order emerges. Socialist economists were convinced, that if people are not kept tight on brain, they are not told what to produce and how much, then everything will fall apart. Meanwhile the economy proved to develop, its elements come together. Supposedly everyone act chaotically, chase for profit, but there harmonic system like USA’s or Japan’s economy comes (Conversation, 2005).

In before we’ll cover above mentioned chaos theory it’s worth to raise one more issue – issue of approach to time. Like professor W. Burszta (culture anthropologist) indicates, human is the only spices in the world of living bodies, that has a need of this kind. We know that there is past, presence and future – it’s the one which fascinates us and we try to plan it, as we are convinced of our immortality. We want to organize time that is given to us. This is what gives our live sense, as while planning, counting on positive happenings in future, we push away problems of getting older and uncertainty of existence. Although today planning, e.g. our own career, even for a few upcoming weeks, is madly risky, to some extent it’s still needful. Life without plans, without expectation comes to be pointless and senseless (Suski, 2011, p. 69).

There are various concepts of time. The most popular is the one in which time is an arrow (see Figure 1) on which we highlight the process of prediction (interestingly, the prediction of the past, i.e., alternate history). Prediction means making inferences about unknown events, based on known events (i.e., those that have already occurred and belong to the past). Unknown events are those that: occur at a later time compared to the time of the prediction (1); occur earlier than the prediction and continue in time (2); occur at an earlier time compared to the time of the prediction and end before the time of the prediction (3) (Donaj, 2012; Donaj, 2013a; Donaj, 2013b, p. 17).

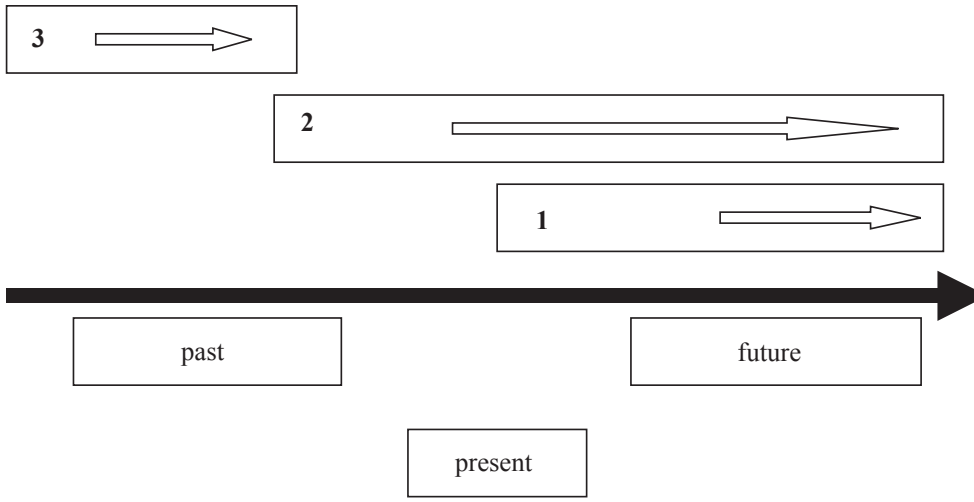

Figure 1. Linear Time

Source: Ł. Donaj.

M. Rowlands[2] in a very exciting book *The Philosopher and the Wolf. Lessons from the Wild on Love, Death and Happiness* wrote that “future is something we actually – and not merely possibly – have now, at the present time (whatever that means). And we have a future because we actually have – now – states that direct us towards the future: desires, goals, projects. Imagine these as arrows streaking into the future. Some of these arrows direct us into the future only implicitly: it takes time for them to reach their mark. To satisfy a desire, you have to survive long enough for the arrow of that desire to reach its mark. The desires of wolves and dogs are like this. However, some arrows are different. Some arrows are burning, ones streaking out into the dark night of the future, and lighting up that future for us. Corresponding to these arrows are human desires, goals and projects that direct us towards the future explicitly by way of an overt conception how that future is to be. Death harms any creature by cutting off the arrow of its desires in their flight. But death harms most those creatures whose arrows are burning ones. It is by way of these sorts of meta-

[2] Mark Rowlands – writer, philosopher. He is the author of a dozen books (and numerous journal articles), translated into fifteen languages. These divide into three categories. The first comprises work in the philosophy of mind and cognitive science, and includes *Supervenience and Materialism* (Ashgate, 1995), *The Body in Mind* (Cambridge, 1999), *The Nature of Consciousness* (Cambridge, 2001), *Externalism* (Acumen, 2003), and *Body Language* (MIT, 2006). The second category comprises work in applied ethics, in particular concerning the moral status of non-human animals and the natural environment. Publications here include *Animal Rights* (Macmillan, 1998), *The Environmental Crisis* (Macmillan, 2000), and *Animals Like Us* (Verso, 2002). The third category comprises cultural criticism, broadly construed, and also attempts to convince the general public of the wonders of philosophy. Publications here include *The Philosopher at the End of the Universe* (Ebury, 2003), *Everything I Know I learned From TV* (Ebury, 2005), and *Fame* (Acumen, 2008). His memoir, *The Philosopher and the Wolf* is published by Granta in 2008. See: Mark Rowlands, http://www.as.miami.edu/phi/people/faculty.html, 3.04.2013; http://markrowlandsauthor.com/, 3.04.2013; Mark Rowlands, https://twitter.com/mnjrowlands?lang=pl, 1.01.2018.

phors that we humans try to understand time. We think of time as an arrow whose flight carries it from the past, through the present, into the future. Alternatively, we might think of time as a river flowing from the past to the future” (Rowlands, 2011, pp. 245–246).[3] “Or we think of it as a ship sailing from the past, passing through the present and heading into a distant and unknown future. We are caught up in this flow of time because we are temporal beings. Like other animals, the arrows of our desires pull us in, and allow us to hook on to, this temporal stream. And unlike other animals, our arrows can, to some extent, light up this stream – making it something to be seen, understood and perhaps shaped.... The present is forever slipping away – the arrow of time constantly passing through one location on its way to the next. So, if the meaning of life is tied to moments, that meaning is also constantly slipping away. The meaning of our life, we think, must be tied to – must be a function of – our desires, goals and projects. The meaning of life is something towards which we can progress; something to be achieved. And as with all important achievements, this is not something that can happen now but only further on down the line. […] But if time is a circle rather than a line” (which can resemble the Ouroboros, the ancient Egypt and Greek symbol depicting a snake with its tail in its mouth which constantly devours itself and is reborn from itself; see the earlier part of this publication on the most serious barriers to predicting, including linear perception of reality, and Figure 2 – author’s note), “if one’s life is destined to repeat itself over and over again without end, then the meaning of lives cannot consist in progression towards some decisive point on the line. There is no such point because there is no such line. Moments do not slip away – on the contrary, they reassert themselves over and over again without end. The significance of each moment does not derive from its place on a line – on how it relates what comes before it on the line to what comes after. It does not carry the taint of past and future ghosts. Each moment is what it is; each moment is complete and entire in itself” (Rowlands, 2011, pp. 246, 254; Donaj, 2013b, pp. 17–18).

[3] That metaphor of the river (understood as a particular river: with no beginning and with no end, and with no banks) is developed by Z. Sarjusz-Wolski (Ph.D. in economics, specialist in organisation and management, author of over 200 publications), who in one of his article cites several concepts of the future. The first of them, that in a way imposes itself is a temporal concept of the future (from Latin *tempus* “time”). It says that the future is simply the time coming. In this case, the place of the river we currently are in is the present. All the water in front of us is the future and behind us – the past. Another concept is the space-temporal concept of the future (from Latin *spatium* “space”), also known as the “world” of H. Minkowski. According to this concept, the river has no springs or mouth, but it has banks, and the banks in the present approach each other at a distance zero. Another concept of the future treats it as a future world or its stretches in terms of future things. Hence the name: reistic concept of the future (from Latin *res* “thing”). Based on this view, we can say that predicting the future is to describe what will happen in relation to things. And in the whole world or (just for some reasons that interest us) in its fragments. Another concept is the so-called eventistic concept of the future (from Latin *eventus* “event”). It is about events that should be understood as something that will happen with anything. There are changes, or processes (kinetic events) and states, or duration (static events). As rightly noted by Sarjusz-Wolski, from the point of view of practical action by governments, parliaments, parties, businesses, organisations, associations, citizens, the last concept of the future is the most important. The subject of predictions, or forecasts are primarily future events. To some extent, these predictions are linked to the reistic concept of the future, because the forecasting and occurring events will shape the world of future things. However, their starting point is predicting these events. See: Z. Sarjusz-Wolski (2005a), *Rzeki czasu. Czas przyszły niedokonany*, „Unia@Polska. Niezależny magazyn europejski”, no. 5/6, pp. 58–59.

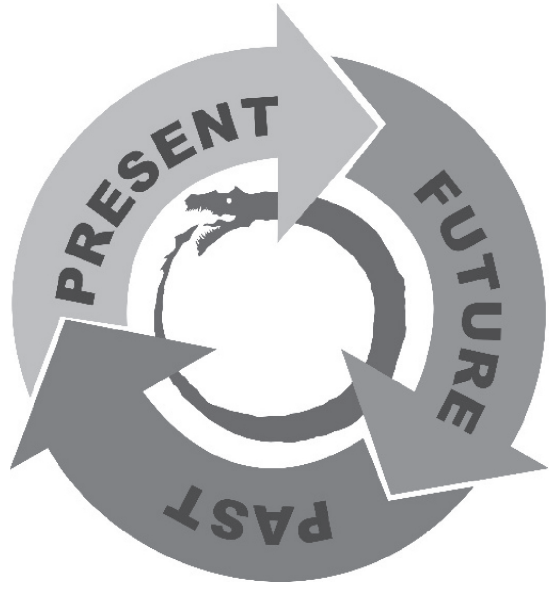

Figure 2. Circular Time

Idea: Ł. Donaj, **realisation:** F. Biały.

M. Rowlands indicates that exactly this kind of circular understanding time characterizes animals:[4] “the time of wolves is a circle, not a line. Every moment of their life is a closed whole. And they always find happiness in an eternal return to the same. If time is circular, it has no ultimate end. Thus, existence is not organised around a vision of the ultimate end.... Where there is no sense of ultimate end, there is no sense of loss. For a wolf or dog death is really the end of life. And therefore death has no power over it. This is the essence of being a wolf or a dog” (Rowlands, 2011, p. 255; Donaj, 2013b, p. 19).

The ponderations concerning time are precious, as – maybe – looking at history from proper perspective, we’ll manage to find regularities that predominate the world. In case of social sciences we can find them among others (at least that’s what their creators claim) in kind of theories like *Modelski’s hegemonic cycles theory*, Kondratiew’s *big cycles of economic situation* or Toynbee’s *cycles of great wars theory* etc. (Modelski, 1987; Gałganek, 1992; Sawin Chase-Dunn, Niemeyer, Alvarez, Inoue, Lawrence, Love).

After Russian economist Nikolay Kondratiew presented the theory of big, in different words long cycles of economic situation, it quickly became an inspiration for other scientists. Despite popularization of the concept “Kondratiew’s cycles” in macroeconomic analysis, and also in regional economic analysis, the term started to be used in theory of development and collapse of societies, as the connection between economy and conflicts was noticed (Sawin). As an example, Arnold Toynbee – about whom below – proposed theory of “great wars” cycles, lasting for period of about 120 years, and divided them for phases: prelude, war, respite, epilogue and common peace. On the other side William

[4] However it should be noticed, that people perceive time differently, depending on culture that they grew in. To generalize – Far East cultures are closer to perceive time in a circular way, whereas Western culture (characterized by individualism, liberalism) tilts to view time in linear way.

Thomson indicates, that “innovative processes and global concentration are connected with global war. Basing on the theoretic arguments and empirical data (of XIX and XX centuries) we noticed, that systematic war is a result of economic innovation and streaming to leadership and, opposite, systematic war influences innovation, economic and naval concentration. In the sense, long waves of economic and technological changes, long cycle of political-martial hegemony and war are strictly connected strength, that is instanced in the center of global economic policy’s functioning” (ibidem). He also underlines, that until today, researches of great cycles identified five global wars: Spanish-Dutch war (1580–1608); war of Great Coalition against Louis XIV (1688–1713); French Revolution and Napoleonic wars (1792–1815); I and II World War (1914–1945) (ibidem; Thompson, 2000, p. 92). As from the above, periods between wars total 80 to 100 years, and in near future there it comes another world war…

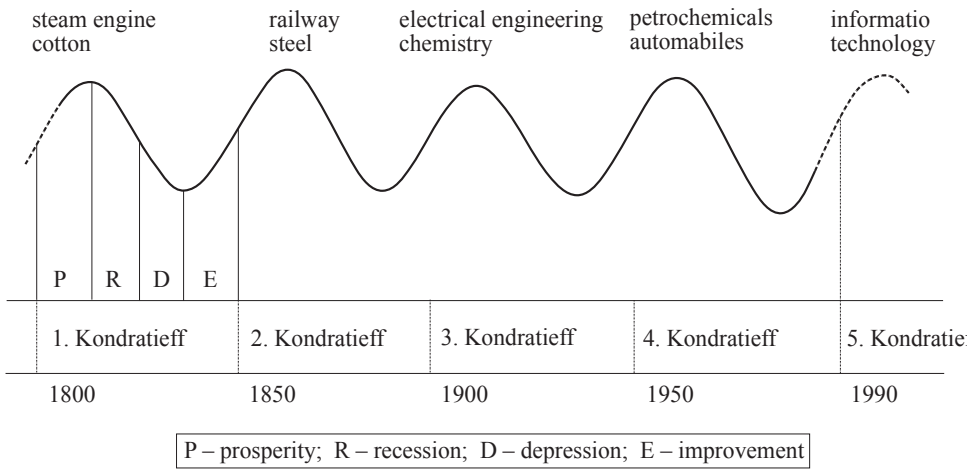

Figure 3. A rough schematic drawing showing growth cycles in the world economy over time according to the Kondratiev theory

Source: https://www.google.pl/search?q=A+rough+schematic+drawing+showing+growth+cycles+in+the+world+economy+over+time+according+to+the+Kondratiev+theory&client=firefox-b-ab&dcr=0&source=lnms&tbm=isch&sa=X&ved=0ahUKEwicoPbztrfYAhUR5qQKHWs7B1QQ_AUICigB&biw=1366&bih=656#imgrc=5ZRQhzvK8pV9TM, 1.01.2018.

Walter Goldfrank from the University of Santa Cruz in California applied a model of Immanuel Wallerstein’s world-system analysis (Wallerstein himself divided cycles for three phases: war, hegemony of one state, its collapse). In a subprovince he included the majority of East Europe states, Russia, Mexico, Columbia, Brazil, Argentina, Chile, South Africa, Turkey, as well as part of Middle East and states of East Asia (Sawin; Goldfrank). As to his forecast, if economically free areas will be developing, leaders position will be taken by three geographically vertical blocks under leadership of the USA, Japan and the EU. In further perspective it may lead to joint domination of the USA and Japan, assimilating both Americas and Pacific Ocean’s region. Policy of the EU will be dominant over other regions, what will contribute, on one side, to duopolar competition system, from the other one – to high level of integration, which attempts are already highly visible (lawmaking’s unify-

ing, transatlantic cooperation etc.). In the world’s scale W. Goldfrank forecasts collapse of present capitalist system and considers four possible models of the system: chaos, fascism, socialist democracy, socialism. First variant is probable mainly as a result of nuclear war’s outbreak or biosphere’s destruction. Second one bases on capitalism’s transformation into new variant of social-economic totalitarianism or on creation of global empire with centered ruling caste which will divide all the rest. Taking into consideration division into states-cores, and states-subprovinces, the last one will be under influence of political repressions, including influence like eugenics and physical extermination. The variant of war is not excluded, what would withstand, in this case, on unsuccessful uprising attempts or protracted conflict. Third and fourth variant of W. Goldfrank’s theory, are described as most desirable models, connected with wealth states, however present tendencies (including global crisis, overpopulation in array of countries and baby bust in others, impoverishment of natural resources, farmland’s abandonment, prices’ increasing in case of food and drink) indicate, that in global scale its doubtable for them to become real (Sawin).

There exists many other views for theory of wars’ cycles and hegemony, among which the most famous authors are G. Goldstein and G. Modelski. G. Modelski called periods of great growth and collapse of empires – worlds’ long political cycles, where – according to analogy with two phases of “Kondratiew’s cycles” – growth phase is called teaching stage and collapse phase is called leadership stage, on the beginning of which global war starts. Each of the periods is divided for four phases. G. Modelski connected influence of Portugal, the Netherlands, and also Great Britain with global policy on historic examples. In case of the USA he presented variant with two cycles. First one had already finished, and it lasted from 1850 to 1945. Second one began in 1971, whereas distraction phase fell for 2000. Afterwards, in 2030 there should begin phase of world war, and in 2050 – another period of global USA dominance (see Figure 4 and 5) (ibidem).

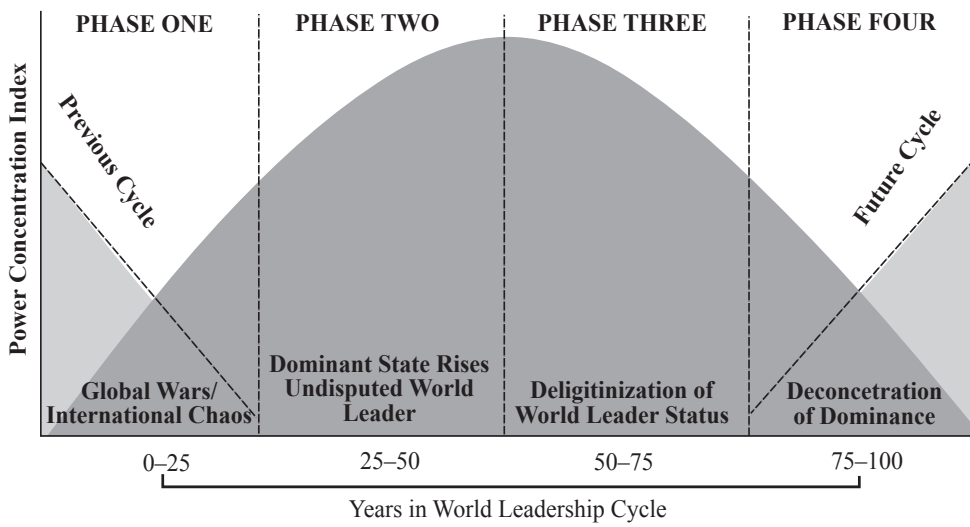

Figure 4. Modelski’s World Leadership Cycle

Source: *Introduction to Modelski’s Model of World Leadership*, https://www.e-education.psu.edu/geog128/node/646, 1.01.2018.

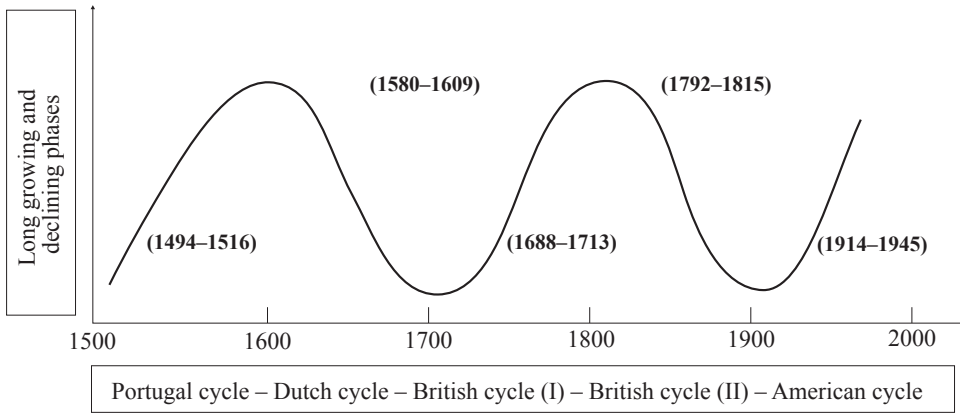

Figure 5. Long Cycles in World Politics

Source: A. Gałganek (1992), *Zmiana w globalnym systemie międzynarodowym. Supercykle i wojna hegemoniczna*, Poznań, p. 74.

Professor Andrzej Gałganek created in turn synthesis of Wallenstein’s systems-worlds and Modelski’s long cycles theory, subsuming historic process as synchronization of political and economic processes in the shape of so-called “supercycles” (see Figure 6) (Gałganek, 1992, pp. 68, 73–74).

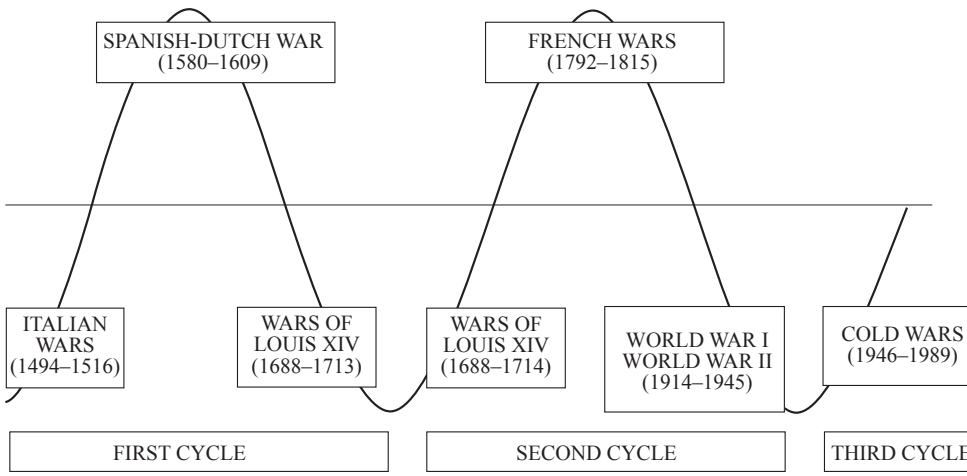

Figure 6. A. Gałganek’s supercycles theory

Source: A. Gałganek (1992), *Zmiana w globalnym systemie międzynarodowym. Supercykle i wojna hegemoniczna*, Poznań, pp. 68, 73–74.

Theory of hegemonic overload is not less interesting. Denis Flooring (Institute of International Research in Seul) believes, that in macrohistorical process of hegemony’s ups and downs, there exist little periods of its weakness and regeneration. As an example may serve the connection between oil shock and recession of 70’s with war in Vietnam, what led to USA’s weakness, and also as another example, success of 1st war in Iraq and

America’s economic strengthening in 90’s. Considering the West’s and USA’s future, diagnosis of D. Flooring, either way is connected with provinces and subprovinces. On one side, today’s West is seen rather as unity, than as a group of states being rivals. On the other side – the culture of the west has been challenged by Islam world, what is more, development of new, reformed superpowers is noticeable. States that may challenge USA, according to D. Flooring, are Russia, China, India (Sawin; Florig, *A Theory*; Florig, *Hegemonic*).

Role ascribed to natural sciences (very close, and in many elements meshing with humanities) in knowledge’s augmentation is connected with mathematization of physics’ language and discovering explaining generalizations. Mathematization of science’s language and discovering universal laws of nature are modern science’s drive (Waszczyk, 2002, p. 40). There’s no wonder then, that humanistic disciplines, like economy or political science, look at natural sciences’ achievements with more and more interest.

Classic worldview, based on Newtonian laws of natural physics, finds its expression in fact, that great creators of western science have underlined generalness and eternity of nature’s laws. They were streaming for forming general schemes of understanding, that would refer to the clearest ideals of rationality. They were searching for pervasive schemes, universal, uniting frames, to indicate, that everything what exists in systems – logically or casual – is mutually connected; they were searching for extensive structures without traces of any crack, through which in and of itself uncontrolled development processes could irrupt, and where everything what is going on should be explained, at least principally, on the basis of the same, persistent nature laws. As opposite to this notion may be considered similarly probable hypothesis, that there is no one universalistic law, there is no one who controls the order, or contrarily, the chaos of our world, that surrounding reality is only reflection of random configuration of many factors (Mańkowski, 2009, p. 1).

As M. Szynkiewicz indicates, desire to understand the world, encompass with mind all its elements and relations occurring in it, constitutes inherent ingredient of ability of reflection over reality, that is assigned to our species. Foregoing experiences, gained during unriddling nature, let us believe in power of human mind. A dream to construct theory that would eventually described chosen fragment of reality, or even whole surrounding us world, may stem from a few basic causes. First of them is conviction about unity and cogitability of the world in which we live, additionally supported with successes in attempts of its rational description. Second one is derivative of characteristic for *homo sapiens* subsuming phenomena, that is one of fundamentals of foregoing success in natural sciences – reductionist methodology (Szynkiewicz, 2009, p. 7).

Reductionism in its most radical view is philosophical; assumes language of physical theories to be horizon of human knowledge about rationale, and physical objects to be the only ones that really exist. This kind of reductionism, also called physicalism, approves also, that physical theories may be expressed with observational sentences about physical objects (Waszczyk, 2002, p. 39).[5]

[5] Reductionism in its heaviest version was formulated as philosophical standpoint, in frames of physical and unification research program of logical empiricism of Vienna Circle. According to this stand, physics is, in terms of research methods and viewed in the widest cognitive aspect object, a model for other sciences, which should be explained in intertheoretical reduction. It means, that other

Crisis of such sciences, like even economy, makes us take a closer look at widely applied reductionist principles. Simplifying reality by disposing entireness for building blocks may cause loosing emergent values (in the simplest view emergent system is the one, that as a whole evinces qualities, that cannot be derived from its every feature; just like word, which meaning cannot be guessed from dotted letters. Principle of preserving complexity while switching from causes to results is in force only in linear world, whereas in real world complexity may rise and disappear alternately. Mind you Aristotle noticed, that entireness doesn’t have to be adjusted to the sum of building blocks (Jakimowicz, 2013, p. 381; Kauffman, 1991, p. 78–84; Schermer, 1995, p. 59–83; *Emergencja*).

However, it should be fairly admitted, that reductionist methodology has proved its effectiveness many times, and foregoing successes of empirical sciences were rising up from works lead in accordance with its indications in a high degree. Still reductionism, including physicalism, in research practice collides with many serious questions. Firstly, having in mind basic demand of adjusting particular natural disciplines to physics’ level, it’s worth to pose a question about its methodological status. As we know, theoretical physics hasn’t yet worked out a model unifying theoretical pictures of its two basic paradigms: quantum mechanics and general theory of relativity. Secondly, effectiveness of analytical methods is based on unspoken assumption, that particular elements of complexed systems in given wholes behave the same (lack of clear qualitative differences) like elements studied in isolation. Thirdly, procedure of dividing on parts seems to be problematic, as it’s revitalized to specified tasks or research specification every time. We don’t even know how to recreate properties of the system on the basis of knowledge about features of elementary components and building complexed systems. Fourthly, reductionist methodology can’t cut description of emergent properties. Therefore the structure of reality itself indicates principal limitations of methodological strategy, which has so prominently benefited foregoing development of science (Szynkiewicz, 2009, p. 110–111; Tempczyk, 2005, p. 157).

Attempts to use reductionist procedures to study nonlinear processes meet serious difficulties. Although reductionism is an effective research method, we are conscious of its numerous limitations (e.g. with reference to dynamic processes – chemical or biological, in which temporal factors play crucial role). As J. Cohen and I. Stewart underline, research on complexity issue has become one of the most important directions of contemporary science development. Numerous problems of analytical method contributed to the birth of chaos theory. It’s not science theory in proper sense and that’s why it cannot be analyzed on the same level with such paradigms of contemporary natural science, like relativity theory or natural selection theory (Szynkiewicz, 2009, p. 112; Cohen, Stewart, 2006, p. 2003; Konarski, 1999, p. 143–148).

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sciences should applied from physics methods as well as ways of viewing a research object to unify it in on one, physical study about the world. From today’s perspective, radical reductionist view seems to be utopian research program, which is impossible to realize. More: M. Waszczyk (2002), *Wpływ teorii chaosu na niektóre tradycyjne stanowiska ontologiczne oraz na spór o redukcjonizm*, „Zeszyty Naukowe Politechniki Gdańskiej – Filozofia”, no. 589, pp. 48–49; W. V. O. Quinn (1969), *Z punktu widzenia logiki*, Warszawa, pp. 35–70; E. Nagel (1985), *Struktura nauki. Zagadnienia logiki wyjaśnień naukowych*, p. 294.

In our conversational understanding, chaos is something wrong; something, that we are not waiting for – further; thought of social chaos fears us, thought of chaotically working nuclear power station etc. Thinking of chaos, we think almost of catastrophe. We would like to have a world and its perception organized, constant and persistent. Some of us after all see world as organized and persistent, possible to restrain, even without new means and tools, some – oppositely: as swirl of strengths and energies, which power seems to defeat our scope, but at the same time constitutes some kind of challenge for a human (Małyska).

M. Tempczyk, considering possibility of chaos theory being scientific theory, pays attention to difficulties with defining extent of analyzed conception and lack of unified system of concepts, methods and statements acknowledged on this basis. It should be also noticed, that answer for question about methodological status of chaos theory considerably handicaps multitude of interpretations of the concept of the scientific theory itself. Theory of deterministic chaos is also known as nonlinear dynamics or complexity theory. It divides studied systems and phenomena for two categories: 1) Linear systems: which particular building blocks are connected, not influencing their all-encompassing properties; 2) Nonlinear systems: which elements show an ability of suiting to each other, thus knowledge considering properties of studied elements in isolation doesn’t allow to formulate forecasts involving their functioning in complexed systems (turbulent flow of fluid is a classic example of this kind of phenomenon (Szynkiewicz, 2009, p. 112–113; Tempczyk, 2001, p. 3; Szydłowski, 1998, p. 159–160).

Chaos theory constitutes one of the most important and the most interesting research areas of contemporary science. Classic attitude, which has been triumphing over two centuries, handled description of linear processes or very similar systems. Development of new mathematics’ branches and advanced computer simulation techniques has given scientists possibility of research and development of nonlinear phenomena. Currently, main stream of chaos theory’s development is connected with searching and analyzing objects’ specific properties, like attractors – understood as defined repertories of potential states of given system (states, that its evolution leads up to). Conducted researches consider phenomena occurring in nature and given social phenomena as well (Szynkiewicz, 2009, p. 113; Cohen, Stewart, 2006, p. 191–193).

The chaos theory allowed us to look at the complex dynamic processes taking place in nature and in society in a new way. Thanks to new mathematical and experimental methods as well as calculation possibilities offered by modern computers, scientists from many fields of natural, technical and social sciences developed adequate models of phenomena which until recently had been too difficult to describe and explain in a scientific manner. That led to enormous progress in those areas. In some of those sciences, those were revolutionary changes, which is why some proponents of chaos theory consider it a new paradigm of science. This paradigm is a complement to the old, reductionist approach to nature processes (Tempczyk, 2002, p. 29).

As A. B. Legocki, rightly points out, to describe a complex whole (or structure), it must first be divided into fragments. However, the methodological improvements should under no circumstances lead to creation of overly simplified nature images, which are essentially untrue (Legocki, 2004, p. 99). Science constantly recognizes more and more new regions of the micro- and the macroworld. But will we ever be

able to unravel the mystery of the unity of the world, its beginning, its duration and its end? Even if we reach its furthest reaches? After all, no species has survived the entire path from the beginning of life on Earth to the present day. Therefore, in some way it must be recognized that time is also an integrated element of nature (ibidem, p. 103). And in that case, maybe time-settled processes are an integrated element of nature as well? including social processes?...

The concept of deterministic chaos appeared in the 1970s in the natural and mathematical sciences. It was used to describe phenomena, which had not undergone mathematization until then. The possibilities of its application were soon noticed not only in physics, but also in biology, medicine, social and economic sciences, and even in philosophy. Political and scientific works began to appear and thanks to them not only specialists from the above-mentioned fields but also the broader circle of readers could become familiar with the concept of deterministic chaos. Deterministic chaos became a trendy concept, and its propagators more and more often talked about a revolution in science, analogous to the revolution that occured in physics at the beginning of the 20th century. It should be considered, after A. Lemańska, whether a theory addressing the deterministic chaos can aspire to be a new science, or a revolution in science, or a new paradigm? (Lemańska, 1999, p. 105).

The phenomenon known as deterministic chaos can arise only in processes, which are described using non-linear dynamical systems. Therefore, exploration, research, recognition of systems with chaos are something that the theory of dynamic systems deals with, which currently is a well-developed and well-established department of mathematics (ibidem, p. 105–106).

And since we talk about mathematics – no wonder that the new solutions that could predict the occurrence of, for example, socio-economic crises, their cyclicality or anticipated moments of occurrence, reached specialists using mathematical methods in their research most often – economists. It is worth emphasizing here that the chaotic complexity, in the context of this article, is associated primarily with the phenomenon of deterministic chaos, but the concepts describing this dependence also include such concepts as: catastrophe theory, bifurcation theory and fractal geometry (Mesjasz, 2014, p. 135).

In his activity, man basically strives to satisfy his needs. Realization of such a task requires a lot of information about the surrounding reality. Satisfying needs of an increasing population can be realized through economic growth. The analysis of markets as well as entire capitalist type economies allows to conclude that development takes place cyclically. After periods of prosperity, there are periods of decline in dynamics, and this is connected with social losses and catastrophes (Pliszka).

As A. Jakimowicz points out, a catastrophe should be defined as a rapid, sudden transition of the tested system to a new state. It does not necessarily have to be worse state than the previous one, so the word “catastrophe” in this theory has a meaning wider than in colloquial use, where it is associated with something bad or dangerous, connected with a defeat. A catastrophe can be boiling water in a kettle, bull market or liquidation of a business. It is about the sudden change in the behavior of the object compared to the average change in the past. Catastrophe theory combines two seemingly conflicting and unrelated types of description of phenomena into one coherent conceptual system: evolutionary and revolutionary, continuity and discontinuity. It allows to show the total

path of the object as continuous changes, which are interrupted by sudden qualitative changes. Thereby, this theory becomes a useful tool in structural research (Jakimowicz, 2005, p. 87).

Catastrophe theory underlines some qualitative properties of systems, which involve:

– discontinuity, which occurs, when set of behaviors of systems is divided for qualitatively different types, and differences between them show up due to constant changes in reasons’ set. Lack of continuity comes from some borders’ existence in controlled space, which make the system oversensitive and even little shifts in parameters may cause relevant change of its structure. An economic example of discontinuity is sharp economic growth, which is characterized by one way of growth being replaced by another, shift of development trajectory or economic game’s rules being changed for different ones;
– divergence (discrepancy) basing on too considerable changes in space of given system’s states being result of low shift of trajectory in parameters’ space, and discontinuous transition doesn’t appear;
– multimodality, meaning, that studied system has more than one state of enduring balance. In economy this feature is obvious. Since J. M. Keynes times it’s well known, that there exists many states of economic balance, but only one of them corresponds comprehensive engagement of all production’s factors. Similarly an enterprise may be in many states of enduring balance (e.g. levelling point and closing point);
– alternativity, occurring, when transition between two points in parameters’ space may be accomplished by continuous changes and discontinuous shifts as well;
– inaccessibility of some states of a system. Catastrophe theory describes most probable states and omits all others (ibidem, p. 87; Kleer, Perczyński, Dobosiewicz, 1989, p. 20).[6]

[6] Catastrophe theory, also called theory of morphogenesis, showed up in science in the middle of 70’s in past century. It’s broad method of systems modeling, underlining the way, in which discontinuous effects may result from continuous reasons. At the beginning it was used to describe development of biological forms, but with time, as a result of interdisciplinary diffusion, it was found to be useful in other sciences. Catastrophe theory is based on typology, so it alludes to a researcher’s geometrical intuition. It describes evolution of dynamic system as process of continuous changes, which in some lags are interrupted by rapid qualitative changes. From here results usefulness of this method to model structural changes of objects. Elementary catastrophe means only rapid shift to a new state and does not have to be connected with any worsening of given object’s characteristic in comparison with previous state. As examples of catastrophe may serve following phenomena: boiling water in a kettle, bull market or liquidation of a business. It’s worth mentioning that many researches seem to indicate that evaluative statement has its equivalent in cultural anthropology. So all human stories, regardless of its enormous number and almost endless wealth of details, may be reduced to seven basic cultural archetypes. Cultural archeology’s research objects were various stories, from ancient myths to contemporary business history. Seven basic points of stories are: 1) Defeating monster. Main character has to fight life-and-death with terrifying, magnificent and dangerous monster (real or imagined); 2) From poverty to wealth (or from mediocrity to fame). Best example here is the Ugly Duckling; 3) Seeking. Character identifies an aim and starts dangerous venture to reach it; 4) Traveling and coming back. Characters leaves well known world to find different one. Then, after dangerous adventures ended by dramatic escape, he or she comes back to starting point; 5) Comedy. After whole bunch of misunderstandings, main characters form a connection, which allows them to

As an example of catastrophe may serve great global crisis of 1929–1933. Beginning of 20th century turned out to be a hard period for states with high as well as for states with low economic grow. Massive pounding were left after I world war and after so-called October revolution in Russia. After finishing warfare in period since middle of 20’s, capitalist states were in phase of economic boom, what lasted until the end of 1928. Economy was coming into phase of balanced development. United States of America were the leader in here. Many crowned heads as well as scientists in social sciences thought, that rules of the market were known, and world was on the way of balanced economic growth. In this self-content it wasn’t noticed that market is not a “machine” and it needs continuous correction (Pliszka).

After many years of practice and experiences, theoretical ponderations, discussions, conferences and analyses it turned out that it’s hard to prevent from catastrophes, natural and economic as well. Economic development is an extremely complexed process and its course meets many constraints and complications, which require bigger alertness from the side of governments and societies (ibidem; Wallerstein, 2004, p. 76–91). Natural factor and social factor obviously influence human’s economic activity (frequently in a chaotic way), but there is hope, that scientific progress will contribute to a better cognition of surrounding, that it comes to act in (Pliszka).

Political scientist is interested especially in possibility of governing such social organization like state. And governing like that – again – is full of situations of chaotic character.

Organization may be treated as system of interpretations and constructions of reality. To survive, organization must find ways of occurrences’ interpretation, to provide itself stabilization of surrounding and strive for increasing predictability of these occurrences. Organization also has to create ways of occurrences’ interpretation, to have the possibility to unify with surrounding, which it chooses (Mesjasz, 2004, p. 51). In theory and practice of management in the majority of cases we deal with nonlinear systems, as between them there are many types of interaction. That’s why it may be claimed, that social systems are subordinated to influence of deterministic chaos. It should be also admitted, that conclusion of this type has a speculative and intuitional character, as in fact it’s social system what is defined in a constructivist way as a rule, what naturally limits possibilities of mathematical models (ibidem, p. 57).

State may be also perceived as peculiar system of logistic character. In this view it seems, that the biggest source of chaos, but at the same time the most empowered to its containment, is logistic system itself. Its elements, in form of infra- and supra-structure, as well as human resources, material, informational, financial etc. are engaged in realization of given activities, as otherwise it only generates costs of keeping them in willing-

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organize occurrences and lead everything to happy end; 6) Tragedy. Weakness of main character or his misunderstanding of his inner self comes to be a reason for array of occurrences leading to catastrophe; 7) Revival. Dark side holds a character in a strong grip. After apparent victory of this strength comes change. Brave man is redeemed, most often by life-giving power of love. It’s hard to predicate, are this archetypes resulting from psychological structures of human’s world understanding, or just derivative of tradition. Catastrophe theory suggests, that they are part of objective reality. More: A. Jakimowicz (2013), *Katastrofy i chaos w wyjaśnianiu złożoności procesów gospodarczych*, „Studia Ekonomiczne”, no. 3(LLXXVIII), pp. 359–362.

ness to handle these activities. That’s why, next to qualitative-quantitative properties of elements of logistic system, their proper interaction (co-influence) in form of real logistic process, including steering activities, integrating, coordinating, harmonizing and the like, are most probably the factors, which critically decide of apparition and liquidation of signs of chaos. As basic instrumental factor in the system is logistics, hardly giving up to mathematical description, the whole wealth of methods and organizational-managing tools, especially integration and group-work oriented, the most proper instrument should be counteracting chaos. Next source of chaos, and at the same time – of ways of its limiting, are elements of logistic system’s surrounding, but inside given subject or system of subjects. It concerns especially functional areas, with which logistics interacts clearly, like trade, production, finances, operational management, strategic management and the like. In this case, conflicts on the point of contact of these functions are basic source of chaos, most often in logistics sphere and outside-logistics areas as well, resulting with dysfunctionality of a whole subject, even whole chain, which this subject is part of. It’s logical, that the way to heal the divisions of chaos’ influence is a decision eliminating conflicts, so decision worked out basing on all possible instruments of informing support for decision-maker, and especially economic bill of global logistic costs, instrumentation of controlling management and the like. In a view of the fact, that logistic system is a part of socio-economic system, maintaining particular relations with it, all of its elements directly or indirectly may cause chaos. Firstly there should be named a client, against which logistic system plays serving role. Especially unexpected changes in market needs may constitute a premise to chaotic behavior of logistic system. Similar situation may happen as a response to all changes on the side of suppliers, mediators and also in a legislative system and system of administrative decisions. Also elements of further surrounding, e.g. economic ones (crisis, revitalization), political ones (authorities’ and public orders’ stability or instability) and the like are only examples of how differentiated may be sources of threats for logistic processes’ stability. It’s logical, that in here may also be seen instrumentation of its limitation (Mańkowski, 2009, p. 5–6; Pluta-Zaremba, 2002, p. 119–132; Walewska, 2008). It should be also underlined, that – as R. Krupski claims – “Every organization (even the bad one), if it exists, it’s because it’s generally anti-chaotic system. Any negative interruptions not only don’t cause rapid strengthening, but oppositely, it’s usually successively suppressed in mechanism of negative loopback. Sometimes management in general is viewed as levelling deviances (interruptions)” (Mańkowski, 2009, p. 6; Gorgosz, 2014, p. 3–13).

Governing a state goes on including taking decisions. These in turn are taken as acts of conscious choice of political activity or its abandonment, which is created on a basis of value code and group of aims preached by decision maker (having power or striving for it). Thereby thesis about politicians’ freedom of taking decisions alludes to attitude, in which being free is connected with truth about him- or herself: human being (politician in this case) realizes him- or herself and makes humanity real by making good to other participants of social life. Considering political decision in this perspective, it should be allowed that basic criteria of politics pursued on behalf of a person and society, is streaming for common good as good of all people and whole human (Sroga, 2000, pp. 473–474, 476–477). Obviously it’s quite altruistic vision, on which – despite egoistic motives of politicians – other aspects of socio-political life cast a shadow over.

Similarly as in strictly business matters, it’s worth to pay attention to the number and the importance of decisions made in situations of incomplete and uncertain information growth in contemporary organizations. Therefore effective human capital management increasingly forces the necessity to take the uncertain phenomenon into consideration. Undoubtedly, managers’ deep knowledge and great abilities in the conscious perception of uncertainty affect success in business. Since, as a rule, they do not have the necessary resources to decrease uncertainty they are forced to learn tools supporting decision making in situations when they have uncertain or incomplete information. The correct understanding of the character of the uncertainty phenomenon enhances the effectiveness of the decision making process and thus contributes to the increase of correct solutions adopted in managers’ every day practice (Redziak, 2013, p. 116).[7]

What is interesting, there has been attempts to use chaos theory in safety studies – so in very “fashionable” science lately (Fairly?... Question requiring individual ponderation). As example, in one of his articles, M. Snopek tried to present, in what ways chaos theory may be implemented in sciences about safety. Such attempts, in social studies, have been made already, especially in economics, where new methods built up hopes for a better understanding and description of market-shaping processes. R. Kruszewski applied the bifurcation model to explain the shape of the demand and supply curves and how they influence the formation of balance on the market. E. Peters became interested in the fractal dimension (self-similarity) of the market, and its impact on investors’ behavior. In political sciences, the possibilities of utilizing chaos theory were demonstrated by D. Richards and A. M. Saperstein. The former proposed a thesis that individual preferences translate into group ones in a non-linear way, and then assumed that this process influences voting preferences. A. Saperstein attempted to determine the impact of chaotic processes on relations between states in an international environment. He also applied chaos theory to answer the question raised by advocates of democratic peace theory: Are democratic countries less willing to wage war than authoritarian ones? Attempts to utilize it were also made in security studies. K. Sienkiewicz-Małyjurek demonstrated that the public safety management system meets all the criteria of a system originating from complexity theory. The literature on the application of chaos theory in analyzing crisis situations is extensive. T. L. Sellnow used this theory to explain the phenomena before, during and after the Red River flood of 1997. R. Hagel, M. Statler and B. K. Penuel used bifurcation in their Encyclopedia of Crisis Management, as one of potential explanations of the occurrence of cascades of crises. M. Speakman and R. Sharpley applied non-linear theory to study crisis management in AH1N1 epidemics prevention (Snopek; Kruszewski, 2014, pp. 125–137; Sienkiewicz-Małyjurek, Kożuch, 2015, pp. 33–43; Sellnow, Seeger, Ulmer, 2002, pp. 269–292; Speakman, Sharpley, 2012, pp. 67–77).

There are two concepts underlying chaos theory. The first assumes that deterministic systems are not a rule but a departure from the rule. The world, therefore, is ruled by chaotic systems. Analysing any threats to system safety allows us to note that crises do

[7] It’s assumed that uncertainty is a situation in which the probability of independence from the decision maker’s will for future states of phenomena or the courses of processes cannot be calculated. At the same time in this situation there is a possibility to identify possible courses of action, determine a set of external world states and assess the results of actions. More: Z. Redziak (2013), *Uncertainty in Decision-Making*, “Zeszyty Naukowe AON”, no. 2(91), p. 119.

not always follow the same course. We can illustrate this with the example of two attacks observed in France in recent years. The first attack (13 November 2015) en-tailed a series of bombing attacks and homicides with the use of firearms. The Islamic State admitted that it had orchestrated the attack, which was conducted by immigrants from Arabic states and descendants of immigrants born in Europe. Despite security measures employed by the services, further attacks took place. In one of these, on 14 July 2016, a man of Tunisian-French origin drove into a crowd of people walking on the promenade in Nice. The Islamic State admitted to organising this attack as well. Despite the incidents being qualified in the same category (terrorist attack), and the terrorists descending from the same environment (Muslims), the attacks were so different that the application of linear methods of terrorist attack prevention may prove impossible. This is due to the presence of a factor characterised by nondeterministic behaviour – human being. Therefore, one can note that the lack of determinism and to some extent chaotic action are natural to the field of safety. The second important concept which underlies the theory in question consists in stating that chaos is not random. Randomness and chaos are two different states. Therefore, the term of deterministic chaos was introduced, which blends the two opposite understandings of stochastic and ordered processes. What makes it difficult to use the deterministic chaos theory in social sciences is the lack of a single systematised definition (Snopek; Krwawe; Kruszniewska, Sepka; Milo, 2013, pp. 425–445).

An interesting attitude to chaos theory may be found in M. Brocki’s publication, who – making use of J. Łotman’s arrangements – referred problems of this theory to social processes – to cultural change. As M. Brocki indicates, historical processes go by predictable, even determined trajectory, which is stopped by explosions, destabilizing moments, but at the same time reinvigorating current system of culture and unpredictably changing development direction of historic processes. Sphere of what is predictable involves “mass” phenomena, repeating ones, subordinated to slow, inertial, gradual development. It also includes cyclical processes. “Explosive” character is in turn assigned to great historical occurrences, activities of individuals, which have significant influence on drift of events, epochal scientific discoveries and technical inventions. In this array Łotman places also all individual „excesses”, including acts of craziness and extreme lawlessness, which may rapidly change development direction and cause sudden shift from one state to another. In “surrounding” of culmination point of historical process’ development, point of bifurcation, show up uncertainty, “ferment” and feeling of inadequateness of foregoing codes that enable understanding of next phases of a process’ unpredictability, rapid increase of systems’ informativity follows on, what constitutes an attempt of finding order in what is new, what – from the point of view of foregoing language and order – seems to be chaos. Receiver, participant of process, actively reacts to brought change: at grassroots of historical process there lies communicational model: communication sources (history’s subjects) send different messages (including ones in form of significant acts), which are received by recipients, who most often is a collectivity, causing maneuverable reactions. Occurrences undergo right interpretation, as they are received in a language, which consists of imaginations of given collectivity, which plays role of social recipient. The same occurrences may be interpreted in many ways, it depends on language that they are received in. It’s important to notice, that attempts to grammatize new one, introduce organization in a place, where it wasn’t present from

the point of view of a process’ participant, what – in effect – allows to impose intelligibility, what not always means understanding in fact. Past as order, is a creature of presence’s experience, as example: disintegration of communist system, together with collapse of local social bonds, common poverty, consumable model of life has procured people outside concrete history, ones, who create it, to be left with collapse and return to myth. They lapse into allegoric associations between “past times” and present day. Past and presence are compared and contrasted, but they are not connected, like in history, by organized order. Past is read with reference to presence: past events are selected and given sense from presence’s point of view, if memories about it are still alive in collective memory. Thereby past organizes itself as text read in presence’s perspective. This way, semiotics characterized occurrences make to see history and form foregoing events in a historic array. That’s how historical experience is being made – it’s not real knowledge, which is gradually placed (cumulated) in time, together with all occurrences, in progressing move of history (in *res gestae* sense), but these cause and effect connections, which are seen from synchronic (current for given moment) point of view. That’s why history cannot teach us – historical experience isn’t something given absolutely and objectively, it changes in time and performs as derivative of our reality. Later there may happen other occurrences, projecting new reading of historical experience, its reinterpretation. Therefore past is read repeatedly from the point of view of changing presence. In this sense history is a game of presence and past. In case of experiencing “chaos” of presence, effect of interfering new order with the old one is escalated by levelling or diminishing values in public past’s discourse (Brocki, 2014, pp. 41–45; Żyłko, 2008, pp. 38–39; Łotman, 1999, pp. 105–119, 186; Uspienski, 1998, p. 9; Ziółkowski, 1999, p. 42; Górny, 2003, p. 114).

M. Brocki claims that from the perspective *emic* (Barnard, Spencer, 1996, pp. 180–183; *Słownik*, 1987, p. 74; Levinson, Ember, 1996, pp. 382–383), bifurcations appear not as particular moments, occurrences, but rather as stretched in time processes of transformations. We see in them described by J. Łotman, but also by J. C. Kaufmann, phases of uncertainty, concern, identified with unfamiliarity of new codes, therefore intensified reflexivity and semiotics of behaviors (attempts to call what follows and to search for common narration, e.g. complaining about contemporaneousness) and reconstruction of order in new reality (Brocki, 2014, p. 48; Kaufmann, 2013, pp. 193–196).

As writes repeatedly called M. Tempczyk, today it’s hard to treat results considering mechanisms of arising chaos as one consistent theory. It’s broad and differentiated area of research, which are connected by irregular, complicated kind of activity, showing up in system, which works in regular way to some point. Foregoing results are promising. They show, that it’s possible to derive this complicated activity from some physics laws applied in complexed systems (at least in some cases). Mathematicians and physicians slowly learn how to file simple moves into complicated whole. A few types of this filing has been distinguished and described by particular scenarios of chaos. Thereupon questions about future of these researches may be asked: Will scientists make it to formulate universal theory, classifying all possible transitions to chaos? Is this theory available of describing all observed in science types of transitions to chaos? After deep familiarization with chaotic dynamics of real systems, scientists may discover types of such transitions, which cannot be subsumed in one explaining scheme. Then the theory would

describe a few scenarios, not comparable with each other, just like it is right now. It may turn out that wealth of natural phenomena is greater that wealth of theoretical models. When we cognize an area of natural phenomena deeper, we start to see not only their unity, but we also start to understand differences between them. These differences may have principal meaning. For these questions there is obviously no answer today and we don’t know how the answer would look like in the future. It’s fast growing area of research, far from maturity and completeness and thank to it the issue of mechanisms is that interesting for philosopher of science (Tempczyk, 2002, pp. 39–40).

A. Lemańska in turn considers theory of deterministic chaos in terms of implying such significant changes in worldview to talk about new revolution, similar to the one from the beginning of century. Thanks to deterministic chaos theory we can have insight into sphere of new phenomena and processes, which until now has eluded from our recognition. So our minds broaden. Theory of nonlinear dynamic systems allowed us to discover regularities hiding outside such phenomena, which until now has seemed to be accidental, chaotic, unpredictable, like weather. Therefore deterministic chaos theory enables it to put into laws phenomena, which until now has seemed to be accidental, where we couldn’t espy mechanisms, which would cause these phenomena and drive them. On the other hand, it allows to understand complexed systems independently from their local ones. In A. Lemańska’s opinion it’s still too less to talk about revolution in science. From formal point of view chaos theory is only a part of broader theory, namely theory of dynamic systems, which uses wide range of concepts and methods of contemporary mathematics’ major branches: mathematical analysis, topology, theory of the multitude, algebra. Chaos theory, at least with current possibilities of solving concrete issues, isn’t at all such universal, as it originally seemed. Its concepts don’t contribute to change of our worldview, although definitely help to understand better some phenomena (Lemańska, 1999, pp. 108–110, 113).

Similar doubts has M. Szynkiewicz, who – considering presumptive finality of relevant conception, by some scientists acknowledged to be revolutionary, or even third most important one, next to quantum mechanics and general relativity theory, theory of 20th century – indicates, that “Final theory is […] kind of regulative idea – final settling is rather an aim and dream rather than real perspective. Faith in reasonability of works over constructing conception with advantage of finality, although unfounded in my opinion, inspires philosophers and scholars since the dawn of time. Most likely this tendency will stay also in the future, and final theory itself will constitute aim such far, and at the same time attractive, as conviction that there is possibility of reaching objective truth” (Szynkiewicz, 2009, pp. 114–116, 146; Horgan, 1999, p. 271; Tempczyk, 1991, p. 227; Tempczyk, 1990, p. 461; Tempczyk, 1995, p. 191; Tempczyk, 1998, p. 68; Turnau, 1992, p. 22).

As famous polish political scientist – professor Andrzej Chodubski indicated: “forecast of future is an important research challenge. It’s dictated by life’s theory and practice as well, and especially – the need of preparing human activity to changing reality of socio-economic and political life. Visions of future constitute relevant incentive activating every point striving for implementation of given aims, aspirations; it allows to analyze contemporary reality substantively and objectively, not only with presence in mind, but primarily with closer and further time horizon”. In his opinion, scientific forecast is

always connected with analysis of given reality, which building blocks are: 1) Revealing development regularities being defined and occurring; 2) Determination of significant value factors, which create development regularities of international relations; 3) Estimation of further development’s conditions and assumptions; 4) Phrasing at the same time brave and real future aims. Analysis should be held comprehensively, i.e. there should be indicated phenomena, subjections, connections, conjunctions, influences etc. (Chodubski, 2009). Starting point in forecasting is usually experience, observation, common sense, intuition and authority figure. These components cannot be overestimated or underestimated. In this respect trust and suspiciousness constitute significant issue (ibidem; Bodio, Chodubski). Including suspiciousness of noted research methods and ones that we connect with other areas, that they do not derive from, as well (like even chaos theory). It obviously does not mean that they could be ignored, but it is by any measure desired to maintain scientific skepticism (Donaj, 2017a, p. 50).

Taking into consideration above mentioned syndromatic character of phenomena – including political phenomena – it’s legitimized for a political scientist to keep research methods of many areas in his or her instrumentation (Chodubski, 2008, pp. 9–32). To be open for interdisciplinarity and do not fear methods that don’t fit humanities of appearances (i.e. games theory, grey systems theory, fuzzy logic, chaos theory etc.). Only then a prophet may escalate certainty of being prepared for challenge. Michio Kaku’s sentence corresponds this fact perfectly: “forecast of the future is a task for more than one man. Scope of human knowledge is just too wide. The majority of forecasts considering science has been found to be erroneous because of the fact, that they reflected only individual point of view – of their creators” (Kaku, 2010, p. 9; Donaj, 2017a, p. 50).

It may be, however, that social sciences, although were found to be useful in analyses of the past, are not really useful when overcoming current problems, and they don’t provide any guidelines for future (Łukaszewicz, 2000, p. 8; Sepkowski, 2011, p. 180). Theory should make it possible to create moderately accurate forecasts, as creating verifiable ones doesn’t seem to be possible at all, if we’ll draw apart self-verifying forecasts from field of attention. Theory not differing enough from guessing is not a useful tool for P. Shively, what may be a little previous (Shively, 2001, p. 31; Sepkowski, 2011, p. 180). But if it’s indeed like that, then vast majority of theories does not fulfill expectations. We confess failures too often, discovering, that we owe it to simple trends’ exploration or to lack of abilities to read modules of past. It seems to be confirmed by constatation of an American historian, E. H. Carr, who was saying: “Studying presence in the shadow of past teaches us also to study future in shadow of presence” (Carr, 1987, p. 86; Sepkowski, 2011, p. 180).

Does searching formulas, regularities, algorithms is doomed to fail? Maybe it’s like in “Π” movie, where genius mathematician Max Cohen is one step from deciphering secret code that gives power over material and spiritual world. His mentor, Sol, tells Him, however: “The ancient Japanese saw ‘Go’ playing boards as model of Universe. In spite of the fact that when it’s empty, it represents very simple system, number of possible combinations is unlimited. They say there has never been two same games of ‘Go’, just like there has never been two same snowflakes. Therefore ‘Go’ board represents unbelievably complicated and chaotic universe… our Universe, Max. Not everything may be described in simple way with mathematics.” Cohen counters with words: “ But together

with a game’s advance, board fills up, possibilities are more and more limited and all moves are becoming predictable. […] So maybe there exist regularities, but we are too limited to see them.”[8]

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Teoria chaosu zdeterminowanego a prognozowanie w naukach społecznych. Przyczynek do dyskusji

Streszczenie

Prognozowanie zjawisk społecznych bywa pod wieloma względami utrudnione. Wynika to stąd, że w naturze tych zjawisk tkwi silne i wielostronne powiązanie z innymi zjawiskami społecznymi; ale nie tylko – także fizycznymi czy biologicznymi (przyrodniczymi). Treścią publikacji jest przedstawienie wybranych problemów prognozowania w naukach społecznych. W artykule skoncentrowano się m.in. na teorii chaosu zdeterminizowanego, na próbie jej implementacji do zjawisk z zakresu (lub z pogranicza) nauk społecznych: ekonomii, logistyki, nauki o bezpieczeństwie etc. Jednym z wątków rozważań

była ponadto próba rozważenia, czy możliwe jest stworzenie tzw. teorii finalnej. Celem publikacji jest zatem zasygnalizowanie możliwości wykorzystania tak zdawałoby się egzotycznej dla „politologów” metodologii modelowania i wyjaśniania zjawisk, mającej źródło w naukach ścisłych (w teorii chaosu), do badania zjawisk i procesów społecznych.

Słowa kluczowe: prognozowanie, nauki społeczne, teoria chaosu zdeterminizowanego, teoria katastrof, bifurkacja

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