Dejana Zlatanovic[1]

COMBINING SOFT SYSTEMS METHODOLOGY AND SYSTEM DYNAMICS: POSSIBILITIES AND LIMITATIONS

The research topic of this paper is the combined use of soft systems methodology (SSM) as an interpretive systems methodology and system dynamics (SD) to develop a functionalist approach in managing problem situations. While some limitations of individual use of SSM and SD can be eliminated by their combined application, some of them still remain. Also, some philosophic, cognitive, cultural and practical limitations of SSM and SD combined use are relevant here.

Keywords: *managing problem situations; soft systems methodology (SSM); system dynamics (SD).*
JEL code: M10.

Деяна Златанович

КОМБІНУВАННЯ МЕТОДОЛОГІЇ СУБ'ЄКТИВНОГО АНАЛІЗУ ПРОБЛЕМИ ТА СИСТЕМНОЇ ДИНАМІКИ: МОЖЛИВОСТІ ТА ОБМЕЖЕННЯ

У статті зроблено теоретично спробу поєднати методологію суб'єктивного аналізу проблемної ситуації та системної динаміки для формування окремого функціоналістського підходу до вирішення проблемної ситуації у менеджменті. Комбінація двох сучасних методологій аналізу ситуацій усуває низку недоліків, що притаманні даним методикам окремо, але не всі з них. Також описано обмеження у застосуванні даної методології – філософські, когнітивні, культурні та практичного характеру.

Ключові слова: *управління проблемною ситуацією; методологія суб'єктивного аналізу проблеми; системна динаміка.*
Табл. 1. Літ. 30.

Деяна Златанович

СОВМЕЩЕНИЕ МЕТОДОЛОГИИ СУБЪЕКТИВНОГО АНАЛИЗА ПРОБЛЕМЫ И СИСТЕМНОЙ ДИНАМИКИ: ВОЗМОЖНОСТИ И ОГРАНИЧЕНИЯ

В статье сделана теоретическая попытка совместить методологию субъективного анализа проблемной ситуации и системной динамики для формирования отдельного функционалистского подхода к решению проблемных ситуаций в менеджменте. Комбинация двух современных методологий анализа ситуаций устраняет ряд недостатков, присущих данным методикам по отдельности, но не все. Также описаны ограничения в применении данной методологии – философские, когнитивные, культурные и практического характера.

Ключевые слова: *управление проблемной ситуацией; методология субъективного анализа проблемы; системная динамика.*

Introduction. In contemorary circumstances, creative handling of management problem situations in organizations implies using different systems methodologies for managing, i.e. structuring problem situations. By critical evaluation and identification of strengths and weaknesses of different systems methodologies, as well as by examining the usefulness of implementing different systemic models, methods and tools within different systems methodologies, it is found that these methodologies

[1] University of Kragujevac, Republic of Serbia.

should be combined. This is the evidence of the fact that problems in contemporary organizations are so complex that individual use of any systems methodology cannot help managing all aspects of these problems. Significantly wider use of combining systems methodologies is demonstrated by numerous researches on the effectiveness of systems approaches.

Research in this paper is focused on the combined use of soft systems methodology (SSM) as an interpretive systems methodology, and system dynamics (SD) for a functionalist-structuralist systems approach. The goal is to show that limitations of individual use of interpretive systems methodologies can be eliminated by joining the adequate functionalist-structuralist systems approaches. According to the specified research subject and goal, the following key hypothesis is determined: Creative improvement of the process of managing problem situations is enabled by the methodologically appropriate combined use of SSM and SD in structuring management of problem situations.

First of all, the relevant conceptual framework of SSM and SD combining – critical systems thinking (CST) is identified in the paper. Based on critical awareness as a key principle of CST, key features and limitations of SSM and SD in managing problem situations in organizations, relevant for their combined use, are considered. Possible approaches to SSM and SD combining, as well as the limitations of their combined use are also elaborated.

Conceptual framework of combining SSM and SD. Combined use of systems methodologies, as a response to increasing complexity and diversity of management problem situations, is established within critical systems thinking (CST). CST is aimed to support holistic managing of the diversity of systems methodologies, that is to explore the ways of appropriate combined use of diverse systems approaches, methods and models in order to respond to complexity, change and diversity of problem situations in contemporary organizations (Jackson, 2010). In fact, CST is a relevant stream within contemporary management science based on the following principles, i.e. commitments (Jackson, 1994; Jackson, 1997: 357; Petrovic, 2010: 74–77): critical awareness, social awareness, dedication to human emancipation, complementarism at the methodological level and complementarism at the theoretical level.

Critical awareness is of particular importance for combined use of systems methodologies concerning the understanding of strengths and weaknesses, theoretical foundation for diverse systems methodologies, as well as examining the usefulness of implementing different systemic models, methods and tools within different systems methodologies. Accordingly, the key theoretical-methodological features and limitations of SSM and SD as a basis for their combined use are briefly presented.

Key features of SSM. Soft systems methodology (SSM) refer to unstructured, ill-defined management problem or messes, i. e. problem situations characterized by complexity and pluralism. These soft situations are characterized by existing of different opposed views on problem situations which results in numerous "relevant problems". In theoretical sense, changing the paradigm of functionalism to the interpretative paradigm is relevant for SSM that implies respecting differences of hard and soft system thinking (Zexian & Xuhui, 2010) such as: understanding the system concept, philosophical base and principles of acquiring knowledge. In a specified context, it is very important to emphasize the following: in hard systems thinking, systems are objective entities of real world, while in soft systems thinking the systems are human subjective construction. SSM representing soft systems thinking tends to involve different perceptions of reality, facilitating the learning process where different viewpoints are examined and discussed in the way leading to purposeful action and improvement. Consequently, the systemicity concept transferred from the real world to the process of inquiry into the perceived real world (Checkland, 2012).

As a learning cycle, SSM consists of the following key stages (Checkland, 2000):

1. finding out about a problem situation through rich pictures and root definitions;
2. formulating the conceptual models of purposeful activity;
3. debating the problem situation by comparing conceptual models with reality;
4. taking action in the situation, i.e. implementation of changes leading to situation's improvement.

As the first stage of SSM application, rich pictures present a holistic tool of the problem situations' presentation. The key participants, as well as their interests, perceptions and interactions are presented in rich pictures. In this way, rich picture of problem situation expresses the viewpoint on which further research of problem situation is conducted (Checkland & Poulter, 2010: 210). Root definitions reflect different perspectives or ways of system's observing, i.e. root definitions can be seen as concise descriptions of purposeful activity system based on a particular viewpoint. Root definitions are not simple empirical descriptions, but representations of what system should be (Christis, 2005). In formulating the root definitions, CATWOE mnemonic is developed, consisting of the following 6 components (Checkland & Tsouvalis, 1997):

- *C (Customers)* – those who have benefits or damages caused by purposeful activity;
- *A (Actors)* – those who would implement purposeful activity;
- *T (Transformation process)* – purposeful activity, i. e. transformation of input to output;
- *W (Weltanschauung)* – worldview which makes *T* (purposeful activity) meaningful in the selected context;
- *O (Ownership)* – those who could stop *T*;
- *E (Environmental constraints)* – elements outside the system taken as given.

While root definitions are representation of the system, i.e. purposeful activity, conceptual models are representations of activities that the system must undertake to be the system named in the root definition (Checkland & Tsouvalis, 1997). Checkland (1996: 170) indicates that conceptual models building should start from the verbs expressing key activities within root definitions.

At the comparison phase, the intuitive perceptions of problem situation are connected with systemic construction. Thus, epistemologically deeper and more general presentation of reality is provided (Checkland, 1996: 177). The relevant result of the comparison phase is assessing the problem situation from which debating on possible changes is derived. The debate should lead to identification of changes that must meet the following criteria: systemic desirability and cultural feasibility (Checkland, 1996:

181). These changes should be implemented, which is the final stage of the SSM application.

In the context of the combined use of SSM and SD, the following weaknesses of SSM are relevant: functionalist systems thinkers criticize the subjectivism of SSM and its failure to provide knowledge about how to design complex adaptive systems (Jackson, 2003: 206). In fact, changes identified by the SSM application can implicitly be contradictory, conflicting or ineffective in the situations characterized by detailed and dynamic complexity. It can be concluded that SSM can not enable cybernetic alignment in the proposed changes (Lane & Oliva, 1998). Following limitation of SSM is also of relevant importance: SSM propose general and often unclear changes and solutions, since they are presented in a form of verbal language i.e. as verbs expressing the key activities to be implemented in real world. At the same time, SSM has no tool to measure whether a particular change implemented in real world was really the one proposed by SSM (Rodriguez-Ulloa et al., 2011). Consequently, SSM need to be supported by some tools of functionalist-structuralist approaches, such as SD.

The key features of SD. System dynamics as representation of hard systems thinking, i.e. as relevant functionalist-structuralist systemic approach to complex-unitary problem situations, is based on the theory of information fedback and control. In order to understand the implications of feedback, it is necessary to know the structure and the dynamics of complex systems. Complex systems behavior is conditioned by interaction among parts of a system, and not by the complexity of parts. It is the basic postulate of SD — system behaviour is conditioned by its structure.

The model is of key importance for understanding SD. Its basic elements are levels and rates. The levels are "the present values of those variables that have resulted from accumulated difference between inflows and outflows" (Forrester, 1972: 68). In contrast to levels, "rates define the present flows between the levels in the system" (Forrester, 1972: 69). For example, number of employee is the level determined by the hire rate and quit rate (Sterman, 2000: 200). Mathematical expression of the SD model is represented by the system of equations (levels and rates equations) that control variable interactions of the considered problem situation that change during time. Since the modelled system moves in time, it is necessary to converse equations periodically. Different softwares (DYNAMO, POWERSIM, VENSIM etc.) were developed to support SD modelling and simulation. Simulation provides revealing the dominant feedback loops as well as predicting the effects of any time delay that can occur in the system.

In spite of different classifications of certain phases, generally, modelling process in SD includes the following activities (Jackson, 2003: 68—69): Above all, conceptualization phase, which clarifies the problem and identifies the variables that influence it. Then, feedback loop model, that reveals relations among variables, is built, i.e. a certain feedback structure is identified. Different forms of diagrams are used in representing feedback structures, but causal loop diagrams and stock/flow diagrams are the most commonly used. That model, in formulating phase, further develops into an appropriate mathematical model, i.e. develop into level and rate equations. Those equations, with the help of certain software, provide relevant computer simulation of system behaviour. Model validity is estimated at the testing phase, and possible ways for improving the results for system functioning, i.e. certain policy designing, are identified at the implementation phase.

Contrary to SSM, SD tries to study social systems "objectively", outside the system and to deal with the complexity of social reality by using the models based on feedback processes. In this way, SD tends to make some simplifications of reality, since diagrams cannot present cultural, ethical and political factors that prevent decisions-makers from reacting in the rational ways prescribed by SD (Jackson, 2003: 80).

Limitations of SD, relevant for combined use of SSM and SD, are related to the process of problem defining and the lack of social-political theory underlying the intervention. The SD modelling process begins by defining specific problem or issue to be addressed. The model should include only variables necessary to study the aspects of situation that are of interest (and therefore to ensure that the models are of manageable size) (Lane & Oliva, 1998). Considering the above, SSM can contribute to improving the first stage of the SD methodology – defining the problem to be addressed, since SSM studies problem situations as a whole from the beginning and does not focus only to one specific problem (Rodriguez-Ulloa et al., 2011). Although there are certain attempts to improve this stage of SD through group modelling (Vennix, 1999; Rouwette et al., 2002) or participative modelling (Lane, 2010), in relevant literature we can observe the necessity to connect soft systems approaches and SD (Forrester, 1994; Lane, 1994; Morecroft, 2007).

Possible approaches to SSM and SD combined use. Combining the systems methodology can be realised in different ways: combining the whole methodologies, combining one main methodology with parts of another and/or parts of several methodologies are combined (Mingers, 1997: 7; Mingers & Broclesby, 1997). The following approaches to combining SSM and SD are presented in this paper: synthesis of SSM and SD, soft system dynamics methodology and combining parts, i.e. some tools of SSM and SD.

Synthesis of SSM and SD implies respecting specified limitations of SSM and SD as well as their theoretical identification. Also, an important criterion is dynamic coherence of systemically desirable and culturally feasible changes identified by SSM. The synthesis can be realized as follows (Lane & Oliva, 1998): First of all, the group of participants use SSM, involving as explicitly generation of multiple worldviews (Weltanschauung) as analysis of norms, values, opinions of relevant stakeholders concerning systemic desirability and cultural feasibility of identified changes (cultural analysis). At the same time, group members regard dynamic coherence as desirable and important, testing the dynamic coherence implies SD tools. Research continues by observing the identified changes as causal structure that can represent the effects of the proposed changes. The causal structure presented by diagrams and intuitive behaviour of specified variables is represented in that way. Appropriate simulation is conducted in order to produce the behaviour representing logical conclusions on causal structure and effects caused by proposed changes. This behaviour is then compared to intuitive behaviour. It is an iterative process of team learning resulting in identifying the final list of changes. These changes are also dynamically coherent because team's intuition concerning the behaviour of the whole to be resulted in changes implementation is consistent with behaviour resulting from causal structure.

As opposed to synthesis, SSDM is a toolkit consisting of 10 iterative stages. It is important that stages 1, 2 and 3 are related to the problem-oriented systems thinking world, while stages 6, 7 and 8 are related to the solving-oriented systems thinking world. SSDM involves the following 10 stages (Rodriguez-Ulloa & Paucar-Caceres, 2005; Rodriguez-Ulloa et al., 2011): 1) unstructured problem situation; 2) structured problem situation; 3) problem-oriented root definitions; 4) building problem-oriented SD models; 5) comparison stage – comparing the stages 4 and/or 7 to the stage 2 (comparing problem-oriented SD models/solving-oriented SD models to the rich picture); 6) determining culturally feasible and systemically desirable changes; 7) building a solving-oriented SD models of a problem situation; 9) implementation of culturally feasible and systemically desirable changes in real world; 10) producing lessons learned. Consequently, it can be concluded that stages 1, 2, 3, 5, 6 and 8 stem from SSM, while stages 4, 7 and 10 refer to SD. This approach is applied to case studies demonstrating its usefulness in solving complex social problems (Rodriguez-Ulloa & Paucar-Caceres, 2005; Rodriguez-Ulloa et al., 2011).

The approach concerning the use of the parts of SSM and SD can be presented as follows: certain tools, i.e. methods and techniques of SSM, such as rich pictures, root definitions and conceptual models are used to examine different perceptions and perspectives of problem situation as well as to identify and represent possible ways of its improving, i.e. to give a sense to problem situation. Systemically desirable and culturally feasible changes are identified by comparing to real world. However, respecting the fact that these changes should also be dynamically coherent, i.e. that the effects of identified changes should be predicted, causal loop diagrams and/or stock/flow diagrams are used to determine interconnections and dynamic coherence of changes. The aim of diagramming presentation of identified changes is to communicate the key features of a SD model to "explain why different behaviour modes arise and why certain policy levers are effective" (Lane, 2008). This provides greater availability and understaning of users, since representing causal assumptions through equations, as well as complex softwares' simulation of behavior are available and understandable only for minority, i.e. for experts. This approach of combining SSM and SD is illustrated in a case study reffering to the combined use of SSM and SD in total quality management (Bennet & Kerr, 1996).

Also, this approach can be illustrated by the following example:

If a research subject is the problem situation of managing corporate social responsibility, then rich pictures, conceptual models and root definitions, as the key methodological tools of SSM, can be used to structure the problem situation, i.e. to present relevant stakeholders, their interests and perceptions of managing corporate social responsibility, as well as key activities to be implemented. For example, one of possible ways for specifying the elements of CATWOE in supporting corporate social responsibility may be as follows:

- C – Society as a whole, national/local economy;
- A – Modern enterprises;
- T – Traditional enterprises – Transformation process – Socially responsible enterprise;
- W – Modern enterprises operate in a world in which there is a tendency towards growing importance of corporate social responsibility as well as its influence on business success;
- O – Employees, professionals;
- E – Legal constraints, standards and guidelines (e.g. ISO 26000).

Root definition: A knowledge-based system concerned with the selected issues according to ISO 26000 (human rights, consumer issues, environmental protection, community involvement and development etc.) and principles (accountability, transparency, ethical behavior etc.) that create behavior may contribute to business success.

According to root definition, the appropriate conceptual models could be built. Then in the process of comparing the conceptual models and root definitions with the real world, an appropriately structured questionnaire can be designed and distributed to a selected sample of enterprises. The obtained research results (for example, the results of descriptive statistics) could be used to determine what activities should be improved, i.e. what activities present systemically desirable and culturally feasible changes (e.g. the activities with lower mean value, $M \leq 3,50$), as the basis for corrective actions. Also, in order to group these activities, factors analysis could be applied.

Before the application of SD tools and in order to predict future effects of possible changes, the correlation and regression analyses can be used. The obtained results may be the basis for stock/ flow diagrams, as well as causal loop diagrams. In that sense, some of the key levels of managing corporate social responsibility identified by factors analysis (for example, the level of socially responsible marketing, the level of post-sales activities contributing to socially responsible behaviour or the level of activities aimed at the protection of health and environment) can be, through appropriately designed stock/flow diagrams, presented as the function of possible systemically desirable and culturally feasible changes with statistically significant effects and the activities before changes. Also, the feedback structure of managing corporate social responsibility can be shown by the causal loop diagram representing possible mutual influences of previously identified levels of managing corporate social responsibility.

The analogous approach to combining SSM and SD (using specified tools of SSM and SD) is illustrated in a case study representing a hypothetical example of qualitative modelling (Coyle & Alexander, 1996), but in this example causal loop diagrams are built first and the rich picture is used to supplement them.

Respecting the fact that SSM and SD are very frequently used systems methodologies for problem situations structuring, combining SSM and SD can be applied in diverse areas. Relying on successful individual use of SSM and SD, illustrated in numerous case studies, some of potential application areas for combining SSM and SD in business economics can be as follows: project management, business strategy, risk management, innovation management, knowledge management, human resources management, corporate social responsibility, organizational (re)design etc. Furthermore, combining SSM and SD can be successfully applied in information systems, education, defense analysis etc.

In Table 1, key differences between the approaches to combining SSM and SD are presented.

Strengths and weaknesses of combining SSM and SD. Respecting the above approaches to combining SSM and SD, it can be concluded that the combined use of SSM and SD enables the identification of systemically desirable, culturally feasible and dynamically coherent changes improving the particular problem situation. Accordingly, the combined use of SSM and SD provides elimination of some limitations of SD related to conceptualization phase and identifying the issue that should be dealt with. At the same time, SSM limitations referring to future effects of proposed changes, i.e. future system behaviour can be removed. Generally, using methodologies from different paradigms contributes to comprehensive understanding of a considered problem situation, since different paradigms ensure different perception or insights about reality that is always more complex than different theoretical-methodological approaches can capture.

Table 1. **Key differences between the approaches to combining SSM and SD,** *author's*

	Synthesis of SSM and SD	Soft System Dynamics Methodology	Combining the parts of SSM and SD
Key assumptions	Limitations of SSM and SD, theoretical coherence of concepts as well as mixing tools during the whole process	Limitations of SSM and SD with the focus on methodological framework, i.e. every stage of SSDM implies using the tools of SSM or SD, without mixing tools during the whole process	Limitations of SSM and SD with the focus on practical possibilities of combining parts of methodologies
Methodological tools	Rich pictures, root definitions, conceptual models, causal loop diagrams or stock/flow diagrams, simulation models	Rich pictures, root definitions, conceptual models, context diagrams, causal loop diagrams, simulation models	Rich pictures, root definitions, conceptual models, causal loop diagrams or stock/flow diagrams
Contribution	Removal of key limitations of SSM and SD' individual use as well as theoretical coherence of concepts	Removal of key limitations of SSM and SD' individual use as well as clear methodological framework	Removal of key limitations of SSM and SD' individual use as well as practical usefulness

However, the combined use of SSM and SD can not eliminate certain limitations of their individual use. Combined use of the considered interpretive tools (SSM) and functionalist-structuralist systems methodology (SD) cannot help dealing with problem situations characterized by unequal distribution of power and information. In fact, combined use of SSM and SD cannot help managing the coercive problem situations. Consequently, it is necessary to include some tools of appropriate emancipatory systems approaches, i.e. critical systems heuristics.

In addition to the already mentioned, the combined use of SSM and SD, as any other combined use of systems methodologies from different paradigms, can lead to a following dilemma, i.e. challenges: paradigm incommensurability, cultural, cognitive and practical difficulties (Kotiadis & Mingers, 2006). To understand the paradigm incommensurability, as the main limitation of combining systems methodologies from different paradigms, of crucial importance is the following (Petrovic, 2010: 587): A group of scientists relied on different paradigms when look from the same point and at the same direction, they see different things.

Cultural difficulties are related to the extent in which organizational and academic culture present the relevant barrier to combine systems methodologies. In fact, one can think that different users are not equally competent in using different systems methodologies (Kotiadis & Mingers, 2006). Cognitive difficulties can be divided into difficulties in shifting paradigms and the personality of systems methodology's user. The following practical difficulties are also important: it takes more time, the lack of experience in using several methodologies, innate conservatism, pressure to do not "risky" by organization/client etc. (Kotiadis & Mingers, 2006).

Conclusion. The key argument for combined use of systems methodologies comes from the multidimensionality of problem situations as well as the fact that no systems methodology can help in dealing with all aspects or dimensions of problem situations. Critical awareness as a key principle of critical systems thinking implies identifying certain strengths and weaknesses of systems methodologies and their combined use.

According to the weaknesses of interpretive SSM and the functionalist SD, diverse approaches to combining SSM and SD are developed – synthesis of SSM and SD, SSDM and combining some parts, i.e. tools of SSM and SD. Despite similar assumptions, key differences between SSDM and the synthesis of SSM and SD are as follows: In SSDM it can be observed what stages stem from what approach, while synthesis includes mixing the approaches during the whole process. At the same time, while SSDM and synthesis imply using the tools of simulating future system behaviour, the approach of combining some parts of SSM and SD does not imply either solution of the complex level and rate equations, or using the softwares simulating future system behaviour. This approach can help overcoming some cognitive, cultural and practical difficulties of the combined use of these systems methodologies (for example, incompetence in using software).

The overall consideration in the paper shows that methodologically appropriate combined use of SSM and SD enables a comprehensive understanding of problem situations as well as improving the process of managing problem situations in organizations. Accordingly, it can be concluded that the key hypothesis in the paper is confirmed.

The paper's contribution lays in the consideration of the relevant issues of contemporary systems science related to combined use of systems methodologies. It is about the review of the findings from this research area. In the paper the possibilities of combined use of SSM and SD in improving problem situations management in Serbian enterprises have not been researched. This presents an area for future research. Also, within future research of relevant importance is researching the possibilities for combining SSM and SD with some emancipatory systems approaches, such as critical systems heuristics in order to eliminate one of the key limitations of the combined use of SSM and SD.

References:

Bennet, L.M., Kerr, M.A. (1996). A Systems Approach to the Implementation of Total Quality Management. Total Quality Management, 7(6): 631–665.

Checkland, P. (1996). Systems Thinking, Systems Practice. John Wiley and Sons, Chichester.

Checkland, P. (2000). Soft Systems Methodology: A Thirty Year Retrospective. Systems Research and Behavioral Science, 17(S1): 11–58.

Checkland, P. (2012). Four Conditions for Serious Systems Thinking and Action. Systems Research and Behavioral Science, 29: 465–469.

Checkland, P., Poulter, J. (2010). Soft Systems Methodology. In: Reynolds, M. & Holwell, S. (Eds.). Systems Approaches to Managing Change: A Practical Guide (pp. 191–242). Springer, London.

Checkland, P., Tsouvalis, C. (1997). Reflecting on SSM: The Link Between Root Definitions and Conceptual Models. Systems Research and Behavioral Science, 14(3): 153–168.

Christis, J. (2005). Theory and Practice of Soft Systems Methodology: A Performative Contradiction? Systems Research and Behavioral Science, 22(1): 11–26.

Coyle, R.G., Alexander, M.W.D. (1996). Two Approaches to Qualitative Modeling of a Nation's Drugs Trade. System Dynamics Review, 13(3): 205–222.

Forrester, J. (1972). Industrial Dynamics. The M.I.T. Press, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Forrester, J. (1994). System Dynamics, Systems Thinking and Soft OR. System Dynamics Review, 10(2–3): 245–256.

ISO (2010). ISO 26000: 2010 ISO. International Organization for Standardization. Retrieved November 2013 from: www.iso.org/iso/social_responsibility.

Jackson, M.C. (1994). Critical Systems Thinking: Beyond the Fragments. System Dynamics Review, 10: 213–229.

Jackson, M.C. (1997). Pluralism in Systems Thinking and Practice. In: Mingers, J. & Gill, A. (Eds.). Multimethodology – The Theory and Practice of Combining Management Science Methodologies (pp. 347–378). Chichester, Wiley.

Jackson, M.C. (2003). Systems Thinking: Creative Holism for Managers. John Wiley and Sons, New York.

Jackson, M.C. (2010). Reflections on the Development and Contribution of Critical Systems Thinking and Practice. Systems Research and Behavioral Science, 27(2): 133–139.

Kotiadis, K., Mingers, J. (2006). Combining PSMs with Hard OR Methods: The Philosophical and Practical Challenges. The Journal of the Operational Research Society, 57: 856–867.

Lane, D. (1994). With a Little Help From Our Friends: How System Dynamics and Soft OR Can Learn From Each Other. System Dynamics Review, 10(2–3): 101–134.

Lane, D. (2008). The Emergence and Use of Diagramming in System Dynamics: A Critical Account. Systems Research and Behavioral Science, 25(1): 3–23.

Lane, D. (2010). Participative Modelling and Big Issues: Defining Features of System Dynamics? Systems Research and Behavioral Science, 27(4): 461–465.

Lane, D., Oliva, R. (1998). The Greater Whole: Towards a Synthesis of System Dynamics and Soft Systems Methodology. European Journal of Operational Reseacrh, 107(1): 214–235.

Mingers, J. (1997). Multiparadigm Multimethodology. In: Mingers, J. & Gill, A. (Eds.). Multimethodology – The Theory and Practice of Combining Management Systems Methodologies (pp. 1–20). Chichester, Wiley.

Mingers, J., Brocklesby, J. (1997). Multimethodology: Towards a Framework for Mixing Methodologies. Omega – International Journal for Management Science, 25: 489–509.

Morecroft, J. (2007). Strategic Modelling and Business Dynamics: Feedback Systems Approach. Chichester, John Wiley and Sons.

Petrovic, S.P. (2010). Sistemsko misljenje, Sistemske metodologije. Ekonomski fakultet Univerziteta u Kragujevcu, Kragujevac.

Rodrigez-Ulloa, R.A., Montbrun, A., Martinez-Vicente, S. (2011). Soft System Dynamics Methodology in Action: A study of the Problem of Citizen Insecurity in an Argentinean Province. Systemic Practice and Action Research, 24(4): 275–323.

Rodriguez Ulloa, R.L., Paucar-Caceres, A. (2005). Soft System Dynamics Methodology (SSDM): A Combination of Soft Systems Methodology and System Dynamics. Systemic Practice and Action Research, 18(3): 303–334.

Rouwette, E.A.J.A., Vennix, J.A.M., Mullekom, T. (2002). Group Model-Building Effectiveness: A Review of Assesment Studies. System Dynamics Review, 18(1): 5–45.

Sterman, J. (2000). Business Dynamics: Systems Thinking and Modelling for a Complex World. Boston: Irwin McGraw-Hill.

Vennix, J.A.M. (1999). Group Model-Building: Tackling Messy Problems. System Dynamics Review, 15(4): 379–401.

Zexian, Y., Xuhui, Y. (2010). A Revolution in the Field of Systems Thinking – A Review of Checkland's Systems Thinking. Systems Research and Behavioral Science, 27(2): 140–155.

Стаття надійшла до редакції 17.10.2014.