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ADAPTATION OF THE SYSTEM THROUGH MANAGEMENT OF ITS CENTER OF GRAVITY

Abstract. In the article, it is analyzed an approach how to lead change to adapt an organization (system) to the environment through influence on the center of gravity (COG) of the system. Leading change of the complex system requires influencing on the COG of the current system through its critical elements and protection of the COG of a desired future system.

Keywords: system, environment, center of gravity, adaptation, leading change, stability, equilibrium, effectiveness.

АДАПТАЦІЯ СИСТЕМИ ЗА ДОПОМОГОЮ УПРАВЛІННЯ ЇЇ ЦЕНТРУ ТЯЖІННЯ

Анотація. Проаналізовано підхід щодо керування зміною для адаптації організації (системи) до середовища через вплив на центр тяжіння (ЦТ)

системи. Керування зміною складної системи вимагає впливу на ЦТ існуючої системи через його критичні елементи та захист ЦТ бажаної майбутньої системи.

Ключові слова: система, середовище, центр тяжіння, адаптація, керування змінами, стабільність, рівновага, ефективність.

АДАПТАЦИЯ СИСТЕМЫ С ПОМОЩЬЮ УПРАВЛЕНИЯ ЕЕ ЦЕНТРА ТЯЖЕСТИ

Аннотация. Проанализирован подход к управлению изменением для адаптации организации (системы) к среде через воздействие на центр тяжести (ЦТ) системы. Управление изменением сложной системы требует воздействия на ЦТ существующей системы за его критические элементы и защиту ЦТ желаемой будущей системы.

Ключевые слова: система, среда, центр тяжести, адаптация, управление изменениями, стабильность, равновесие, эффективность.

Target setting. Resistance of the system to change does not support its adaptation under influence of the changeable environment. To adapt the complex system in order to maintain its effectiveness requires researching essential questions about when and how to lead change.

Analysis of the recent research and publications. A social system is a complex system with a big amount of agents that can behave in unpredictable ways. Jones Wendell supposes “In complex systems, the connections are critical, but individual agents are not [1].” He explains, “Simple rules result in complex and adaptive responses — they are not predictable. Each of the agents has a choice of responses within the confines of the rules” even they are based on similar believes, values, and national culture.

To lead the complex system may require identification of a certain critical element such as the COG of the system to create and implement change. The

COG is one of “primary sources of moral or physical strength, power and resistance” [2, p. IX], a key notion of the system. Identification and managing of the COG may help to lead the complex system properly. The COG has its critical elements (figure 1) such as critical capabilities (CC), critical requirements (CR), and critical vulnerabilities (CV) [3, p. B–3]. The COG and its critical elements present a foundation for design of change that should logically explain how to adapt the system to the environment and/or shape the environment in order to achieve the goal.

Dr. John Kotter proposes 8-stage process of creating major change. It includes “establishing a sense of urgency, creating the guiding coalition, developing a vision and strategy, communicating the change vision, empowering broad-based action, generating short-term wins, consolidating gains and producing more change, and anchoring new approaches in the culture” [5, p. 23]. All stages above are relatively

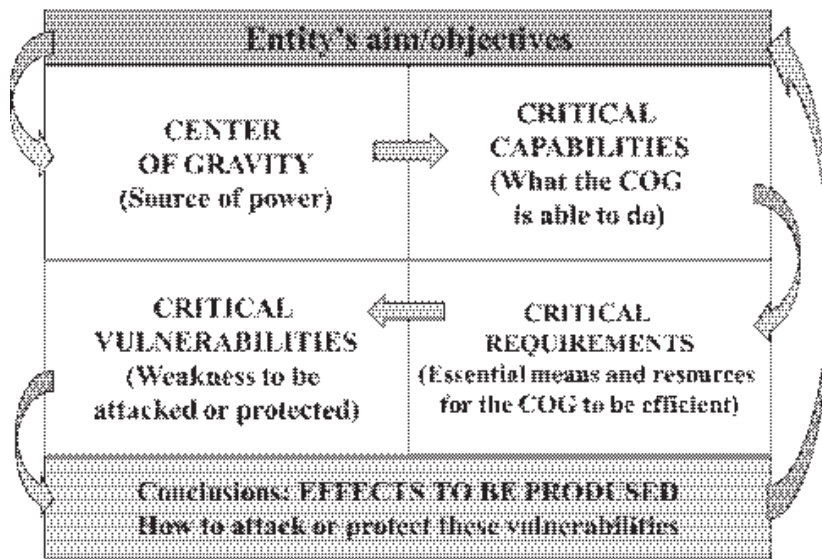


Fig. 1. Centre of Gravity Framework

Source: adapted by the Author based on the “Centre of Gravity Analysis Matrix” [4]

common for a human system. It is possible to assume that they are connected with critical elements of the system COG. For instance, “establishing a sense of urgency” may be similar to understanding the problem and the need of change. “Creating the guiding coalition” can be connected with identification and protection of the COG of the future desired system. “Developing a vision and strategy” coincides with visualization of a desired end-state, developing operational approach and design. Thus, it is possible to assume that the notion of COG and its critical elements can be applied to lead change.

Both, leadership and management are involved in leading change. Leadership of change combines “establishing direction, aligning people, motivating and inspiring”. It leads to change, growth, commitment to the vision. Management encompasses “planning and budgeting, organizing and staffing,

controlling and problem solving”. It produces a degree of predictability and order [5, p. 29].

Dr. Peter Senge in his book “The Fifth Discipline” introduces the notion of the learning organization [6, p. 3–4], as an alive, agile and adaptable system with delegation of authority, decentralized command, constant feedback, creative and motivated environment. This system adapts to the environment quickly and maintains equilibrium between the system and the environment. To create this organization he proposes to use five disciplines to lead change: systems thinking, personal mastery, mental models, building shared vision and team learning [6, p. 6–9].

To implement change the leader has to make a decision based on experience, current data, a feedback loop, human perception and national, organizational, and decision-making (DM) cultures [7, p. 3]. DM process takes time

because the system reacts to the environmental change with delay. Coefficient of dynamic equilibrium (K_{eq}) between the system and the environment defines this delay [8, p. 9] and shows how the system and the environment fit with each other.

Thus, recent researches and publications present leading change as theoretical description relationships between the system and people, but they do not provide a practical tool for the leader to adapt the complex system to the environment based on notions of system stability, equilibrium and the COG.

The purpose of the article is to analyze the approach how to adapt the complex system, develop theoretical interpretation and a practical tool to lead change through influence on the COG of the system.

The statement of basic materials. Technological development, globalization, a big amount of players, and intensive communication networks continuously change the environment. It disturbs equilibrium between the system and the environment. In these conditions the system can start losing effectiveness quickly without adaptation.

Leading change is a complex process that assumes second and third order effects based on a certain degree of chaotic interactions among system agents. The notions of balance, equilibrium, and the COG of the system may be fundamental in order to understand how to lead change, make decisions and develop reforms for system adaptation.

System development presents a cycle process of transition from an obsolete structure to a new one. The system forms a structure in order to survive and be safe in the given conditions be-

cause the structure is stronger than chaotic and vulnerable combination of independent elements of the system. A structure organizes coexistence of system elements in the best way based on common rules of behavior (organizational, national culture). A new structure appears in a certain moment as system adaptation to strong interior and/or exterior influences on the system. Satisfaction of growing human needs is an example of interior system change and technological innovations and revolutions are examples of exterior influence. An organization presents a human system with social and individual development under influence of environment and personal human traits, mental models that are presented by organizational, national, and corporate cultures.

On one hand, system development looks problematic because stability means no changes. On the other hand, continuous controlled change can establish maximum system balance and, therefore, stability. It is possible to imagine system stability as physical system stability and human stability of team members based on mental models that are fundamental and the most difficult for change. Change assumes risk because it can damage system stability.

To maintain equilibrium between the system and the environment and achieve the end-state may require system adaptation to the environment and neutralization of the COG of the environment (opposing side) – shaping of the environment. It is possible to shape the environment and still keep a previous system structure, but in many cases, in conditions of complex and changeable environment, system adaptation is getting primary.

System adaptation is transformation of the system through the chain of different reforms (events, efforts) that are combined in operational design (OD) (figure 2). To identify which reforms the system needs it is important to understand the end-state, the environment, the COG of the current system and the COG of the desired future system.

To understand leading change in the framework of OD requires clarification of notions of own system and an opposing system (side). The opposing side is a system that you are going to influence (change) when own system you are going to protect. It is possible to imagine an opposing side as own system that resists changing. Thus, the old system is the opposing side and a desired future system is own system.

There is a paradox of system development: the system should be adapted to the environment and the system resists changing in order to protect itself from destruction. On one hand, the COG provides system resistance,

therefore, to protect own COG is important. On the other hand, it makes the system not adaptable. The COG is a key concept of any system that defines its stability. To manage the COG means to control system balance. To influence on the system COG means to influence on system behavior by minimum means. It is like “precise target shooting at night with a night-vision device”.

Understanding of the need of change and visualization of the design to implement this change facilitate inspiring superior leaders and subordinates to adapt the system quickly. The COG of the own system and the COG of the opposing side present a basis for OD to achieve the end-state and maintain equilibrium between the system and the environment.

The logic of the OD is to assemble actions in space and time to establish conditions required to deactivate the COG of the opposing side while defending the COG of own (desired) system that is presented by an innovative coalition. Thus, leading change means

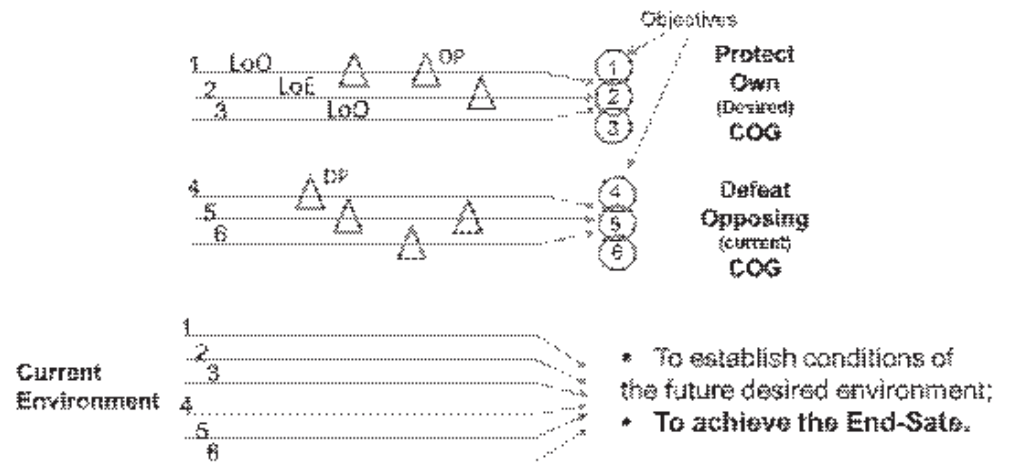


Fig. 2. Operational design framework
Source. Created by the author

management of the COG as transformation of the COG of the obsolete system to the COG of the desired future system.

The elements of the OD are decisive events (points)(DPs), lines of operations (LoOs), lines of effort (LoE), objectives, and the end-state (figure 2). The OD should present “the concentration of strength against weakness” [9, p. 334]. CRs and CVs can become decisive Events or Points, Tasks, Objectives or Missions. Logical groupings of related CRs and/or CVs can become Lines of Effort/Operations [10].

Dale Eikmeier explains relations between the COG and its critical elements (figure 3). One of the means that is able to perform CC is the COG and CRs and CVs are supporting elements of the COG.

Also he proposes a method to identify the COG of the complex strategic system in the framework of Ends, Ways, and Means (figure 4). Properly identified COG is vital to leadchange successfully. “Does or Uses Test [10]” separates

the COG from its critical elements. The COG: 1) *Supported/Does* — inherently capable to achieve the specific task or purpose as defined in the “Ends;” executes the primary actions (critical capabilities) that accomplish the “way;” does the action and uses resources to accomplish it; 2) other means (*Supporting/Used*) — are used or consumed by execution of the primary actions (critical capabilities); contribute to, but does not actually perform the critical capabilities.

The logic of the OD should prove the validity of critical elements of the COG. The author suggests if CCs, CRs, and CVs, as possible objectives/decisive points, do not support effective achievement of the end-state in the framework of the OD, it means that they are not critical for the COG or they are not CCs, CRs, and CVs at all. If achievement of the end-state is problematic and takes a relatively long period of time or we do not understand the end-state clearly, it means that the identified COG is wrong. A properly

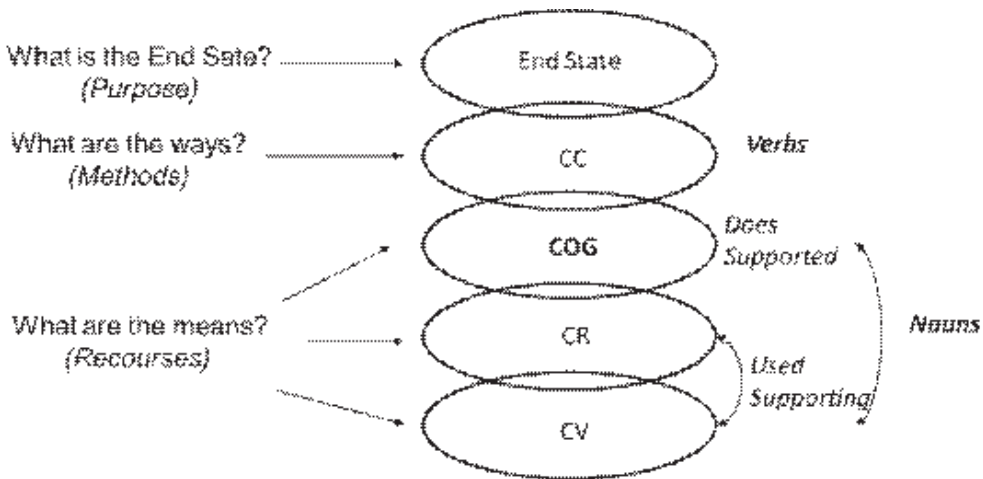


Fig. 3. The structure of relations the COG with its critical elements

Source: [10]

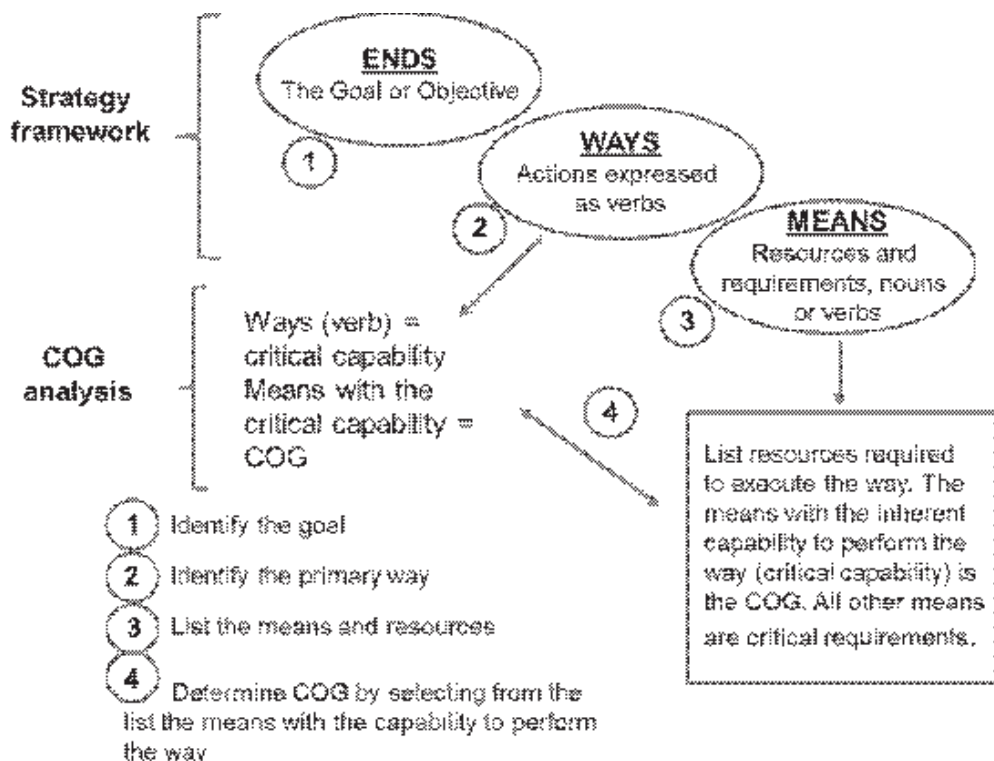


Fig. 4. A method for COG identification in the strategic framework

Source: [11]

identified COG allows building effective OD to achieve the end-state by minimum means.

To create a new system requires visualizing of a new COG that should be protected in advance. For example, one of the stages of the leading change process according to J. Cotter, “creating a guiding coalition”, may be considered as a COG of the future system. Also, stages “developing a vision and strategy, generating short-term wins” can allow decreasing system vulnerability in a period of transition or shift from the current structure to a new one. To protect the COG of the desired system is important to understand and visualize possible system behavior. The iPhone brand and its motto – “Giving people

what they think and not just people want” can be an example how to lead people and force them to buy its products.

The notion of COG is directly connected with system stability. Therefore, understanding of the COG conception may help a leader to save system stability and impellent change. There are three type of equilibrium: stable, unstable and neutral equilibriums (figure 5).

The leader should be skillful in managing system equilibrium in order to save its functionality. For example, adaptation requires unstable equilibrium when system is vulnerable and ready to take any structural change. In this moment a system looks for the best position, place in the new environment



Fig. 5. Types of equilibrium

Source: [12]

and a leader's role is to direct this system on the right way — to save system functionality through adaptation to the environment. After that, the system can take a position of stable or neutral equilibrium again.

Unstable and neutral equilibrium may characterize flexible sensitive systems such as learning organizations. The unstable system is easier to influence than a stable one. To implement change requires establishing of conditions of unstable or neutral equilibrium. The process of system development is discrete, but the learning organization has continuous feedback that may be even invisible. This organization implements change quickly without big resistance and has K_{eq} that tends to "1". It allows keeping system effective and competitive with others.

In many cases, the system may have an "irregular" shape due to complexity and dynamic of change. To find the COG may require continuous feedback about a "shape" of the system. The COG can be changeable [13, p. IV–24] and, probably, hired and invisible. Thus, to monitor the COG is a complicated process.

System adaptation to the environment or/and shaping of the environment in advance or, at list, in time may provide stable equilibrium for the system. Misunderstanding of the environment and the system, because of weak

leadership and feedback, does not facilitate adaptation and makes the system not effectiveness. Growing conflict between the system and the environment creates unstable equilibrium and, eventually, destroys equilibrium at all.

The author suggests that there is a certain critical K_{eq} (K_{eqcrit}) when the system starts losing stability without a possibility to be restored and eventually creates a new structure. It may correspond to a bifurcation point. It is possible to assume that K_{eqcrit} may be the same for any system under conditions of similar human perception, sensitivity, culture, and other. One of the important system characteristics can be speed of system adaptation (V_{ad}). The first derivative of K_{eq} may describe this speed:

$$V_{ad} = f'(K_{eq}).$$

Delay in system reaction due to system resistance, inertia of the DM process, time for implementation and feedback can define V_{ad} .

V_{ad} describes dynamic of system adaptation. The inequality $V_{adx} > V_{ady}$ means — the system X is more adaptable and effective than the system Y . For example, the system X is less effective ($K_{eqx} = 0,4$) and the system Y is more effective ($K_{eqy} = 0,7$), but $V_{adx} > V_{ady}$. It means that in this moment the system X is more adaptable than the system Y . Speed of system adaptation (V_{ad}) can define also success of the leadership. An example of the successful leader can be

Louis V. Gerstner Jr., a chief executive officer of the IBM, who has headed the company for nine years (1993–2002). He revived the IBM from stagnation by successful leading a dramatic change [14, p. 88].

System adaptation may require replacement the COG of the system by a new one, for instance, through change of the system structure or organizational culture. In this period, the system becomes unstable and vulnerable. Providing dynamic equilibrium between the system and the environment may maintain system effectiveness under condition: $1 > K_{eq} \geq K_{eqcr}$. In this case, the system should be adaptable, but open in a certain degree to keep functionality. If $K_{eq} = 1$, the system is in the process of endless change which is impossible to control.

When the system is about to achieve the K_{eqcr} , usual Ways and Means do not help anymore to achieve Ends and without further adaptation, the system can start losing effectiveness up to complete destruction. For instance, it is possible to suppose that Ukraine today is in conditions of unstable equilibrium or non-equilibrium due to low adaptation to the fast environmental change. It makes the current Ukrainian system not effective. On the other hand, instability gives Ukraine, as a social system, an opportunity for quick adaptation by a proper leading change.

Understanding of the place of the COG, vision of its possible movement (because of the need of structural change as part of adaptation to the environment) and the environmental dynamic may provide required system effectiveness. To control the COG of the system and the environment is primary.

It can be a process of monitoring of the situation and system balance through the change of the COG as a structural change. Thus, predictable change may determine a future COG of the system. For instance, if moral is a probable COG of the nation, it is possible to observe replacement of the Soviet mentality, as the COG, by a new Ukrainian COG that is still in condition of forming. The Soviet values have not been fully replaced by the Ukrainian values because of lack of their credibility, weaknesses and some disadvantages (for instance, a low level of life for majority of population). It means that the equilibrium between the new environment and the system has not been established yet. The system is unbalanced because of its COG is located outside of the system's base (high level of Risk). Thus, it is possible to consider that the current Ukrainian system is obsolete due to lack of adaptation to the environment. Thus, leadership has to find own COG and the COG of opposing side, and then to balance the system through system adaptation (leadership influence, structural system change) or/and shaping of the environment in order to restore equilibrium between the system and the environment.

To define the COG of the complex system may require determining of the dimensions of possible system's movement in 3D space. Drawing the main lines for each dimension can help to find the point of intersection of all of them. There is only one point, which is a system's COG. Thus, it is possible to assume that the COG is only one for each system in a certain moment. Position of the COG determines possible stable, unstable, and neutral equilibrium of the

system [figure 5]. A process of synchronization Ends, Ways, and Means in the framework of possible permissible Risk [15, p. 82] presents a basic principle to create the OD to make system effective through providing equilibrium between the system and the environment. Possible permissible Risk means a level of risk when the system is still able to return to its original position after influence by a signal. This system is in a condition of stable equilibrium.

In case of stable equilibrium, the system may have enough Means to maintain relative equilibrium with the environment. For unstable equilibrium Ways may be more decisive in comparison with Means. Thus, dynamic of leadership and speed of system change (V_{ad}) becomes primary.

Physically, the system becomes unstable when the COG falls outside of its base. It corresponds to Keq_{crt} . The available system's Ways and Means may present this base. The location of the COG, size of the system's base may determine the system stability. For instance, the cone is very stable because "low COG" (low Risk) and "wide base" (figure 5). The system becomes unstable when the COG falls outside of its base. Unbalance of Ends, Ways, and Means moves the COG outside of system's balance. It is a point (position) of dangerous risk when the system starts losing stability and becomes unmanageable ($K_{eq} \rightarrow K_{eq_{crt}}$). To restore balance a leader should make decision to develop a course of action (COA) as a way to keep system functionality through application of the OD.

Leading change requires applying of the philosophy of adaptation based on systems, critical and creative thinking.

They are vital to understand thinking and DM culture of the opposing side. It helps to visualize outcomes of mutual interactions on the way to achieve the end-state through operational art and design. It is a key in order to do right things according to a measure of effectiveness (MOE) and do it properly (we are doing right things well) according to a measure of performance (MOP) [16, p. 15–2]. These measures can be created based on the approach to get maximum result with minimum expense (min-max criteria).

A flexible system (a learning organization) allows revising of goals and leaving a place for negotiation. To find the best alternative to a negotiated agreement (BATNA) [17, p. 50], as a philosophical solution, for all sides of the conflict is mutually profitable. Applying of combination of domains of national power such as Diplomacy, Information, Military, and Economy (DIME) may play an important role to create flexible OD. This approach can leave a possibility for future negotiation with the opposing side and achieve the end state by minimum means.

The notions "To win" and "Do not lose" present two different approaches to achieve the end-state. "To win" can be connected more with a military objective. It sounds optimistic and brave, but has high risk and expectation of deep disappointment from the opposing side. If "The object in war is a better state of peace — even if only from your own point of view" [9, p. 338], the option "do not lose" would be an attractive philosophical objective because it assumes possible future cooperation. In addition, it has lower risk then option "to win".

The decision-making model “To win”, in many cases, generates mistakes and does not leave the place for the BATNA in comparison with the model “Do not lose.” For example, the results of the Second World War generated confrontation — “A Cold War,” collapse of the Soviet Union has damaged existed equilibrium and created regional conflicts. The position “to win” presents a DM model — “I and my enemy” that does not leave a big opportunity for negotiation. Thus, understanding of philosophy of adaptation based on national and DM cultures may create the “Wise Decision-Making” to maintain equilibrium between the system and the environment without intense conflicts.

To balance ends, ways, and means in the framework of possible permissible risk allows achieving the goal by less means and the simplest ways [15, p. 87]. The leader should communicate with the audience and explain the need of risk taking in order to implement change. Peter Bernstein said “Risk means we are not in danger, we are in unknown situation [18].” A leader should recognize a favorable moment of coincidence of the circumstances to take risk and get synergy effect. This moment may correspond to the condition when K_{eq} is approaching to K_{eqcr} .

Thus, based on the logical connection “Risk – Equilibrium – System Balance” a learning organization can be the most balanced system ($K_{eq} \rightarrow 1$). This system is always in condition of change (adaptation) and does not have leaps in its development because the problem is recognizable by the system on the very early stage. Risk taking adapts the system through innovations and structural change and decreases overall system

risk [15, p. 83]. It explains the paradox of stability of the system in spite of its openness and vulnerability. The open system has high V_{ad} due to quick reaction to the environmental change through communication and feedback.

To keep system effective and balanced the author proposes to use an algorithm of leading change through management of the COG (figure 6). The idea of the algorithm is to observe relationships between the system and the environment based on K_{eqcr} , V_{ad} and in case of need to create change and lead it.

The process of maintaining of dynamic equilibrium between the system and the environment allows saving system effectiveness [7, p. 3] through change of the system and/or the environment. The role of the leader is to lead change based on understanding of the level of equilibrium and dynamic of system adaptation. There are essential and sufficient conditions to initiate change. The essential condition answers the question: is $K_{eq} \rightarrow K_{eqcr}$? The sufficient condition answers the question: is K_{eqcr} achieved? In general, these conditions answer the question: does the system effective enough? The leader has to recognize these conditions and start leading change by managing the COG of the system with its critical elements in order to save system functionality and achieve the end-state.

At first, the leader has to create change through clear understanding of the problem, visualization of the desired future system and the environment, and identification and monitoring of the future desired system COG and its critical elements. Second, the leader has to lead change through initiation of

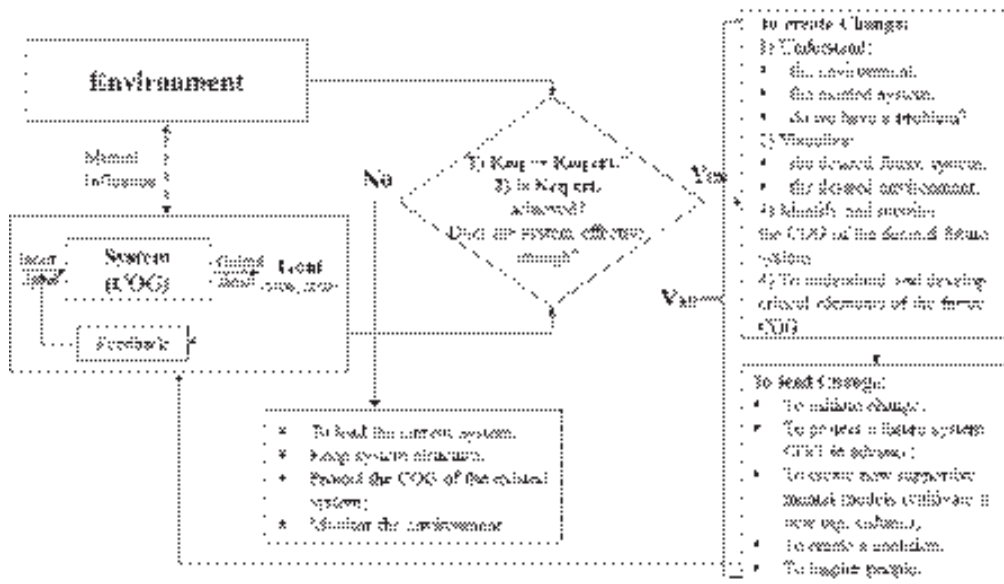


Fig. 6. An algorithm of leading change through management of the COG

Source: created by the Author

change, protection of the future desired system COG in advance, establishment of new supportive mental models (cultivate a new organizational culture), building of a coalition, and inspiration of people. Speed of system adaptation (V_{ad}) can define success in leading change and system effectiveness. If the system is effective enough the leader's tasks are to lead the current system, to keep its structure, to protect its COG and monitor the environment.

Conclusions. To summarize, unstable and neutral equilibrium may be characteristics of the learning organization as a sensitive system, which is highly adaptable and flexible. The condition of unstable equilibrium makes the system changeable that allows managing the system through influence on the COG and its critical elements. The leader should lead change through building of the operational design based on the identified COG of the current

system and a visualized COG of the future desired system. The proposed an algorithm of leading change through management of the COG is a practical tool for leaders to implement change in order to keep system effectiveness through maintaining of dynamic equilibrium between the system and the environment.

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