

# Swarm-like Dynamics and their Use in Organization and Management

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## 1. Introduction: Swarm-like dynamics

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According to many authors in the field of management, today's globalization, rapid-fire technological innovations, and constantly mounting pressure from a few elitist, unimaginably rich, banking corporations have pushed the world markets into a state of ceaseless turmoil. "Success amidst such a maelstrom of change"—writes Conner [1] in his book *Leading at the Edge of Chaos*—"calls for much more than what change-management models have to offer. It calls for the emergence of a radically new kind of organization with highly flexible *swarm-like* dynamics, nimble enough to adapt instantly to changing market conditions, and piloted by people well versed in the art of riding complexity at the edge of chaos."

Study of the swarm-like dynamics is at the focus of the Artificial Life research program of Langton [2]. He has been the primary motivator behind the development of a simulation package called *SWARM*—a software package for modeling swarming behavior of networks with agents capable of acting autonomously to produce higher-level identities, such as the flocking behavior of birds, the swarming behavior of bees, the concourse of people, and so on. Since 1997 Langton has been with the Swarm Corporation, aimed at providing expert consulting and modeling capability to businesses and other agencies facing whirling complex dynamics in various aspects of their organizations.

Swarm-like dynamics are at the very core of the dynamics of every organization. This paper reveals their use in the practice of management.

## 2. The swarm of human thoughts and feelings

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Although every organization represents a system with an established order: structure, hierarchy, and links with the environment, it is clear that the thoughts and feelings (shaped into ideas, emotions, aspirations, expectations, hopes, dreams, and so on) of people working in organizations can hardly obey any pre-imposed order. Being extremely sensitive

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to any (even the slightest) interference, they cannot be pushed into a systemic order—they keep constantly swarming—diverging or converging, unfolding or enfolding, forming transient patterns that expand or shrink in a difficult-to-predict rhythm. The space where they “dance” can be called a mental space—a nonmaterial (transcendental in kantian terms) space that belongs to each and every individual able to think and feel.

Explicit knowledge is that knowledge that is written down or in a knowledge base. Tacit knowledge is that knowledge that is in the heads of the agents. The greatest knowledge base in the company is the tacit knowledge in the heads of the people that is continuously changing and evolving. (R. Buckman)

People do not like to compare their thoughts and feelings with swarms. We like to believe that what we think and feel: what we conceptualize and saturate with emotions, what we expect and aspire, what we hope and dream gives us identity and power in the world, so we do not want to accept that we are in any way like bees in a swarm, or birds in a flock, or ants in a colony.

“Why is it unpalatable for us to accept that our complex human behavior may have a simple nonhuman explanation?” asks A. Battram in an internet discussion on organizational complexity.

Swarms are characterized by the seven unique properties:

- wholeness
- intensive interactive dynamics
- flexibility
- high level of potential for formation of transient dynamic patterns and accomplishment of coherent actions
- alertness
- receptiveness
- criticality (edge-of-chaos behavior).

These properties endow the swarm with an exceptional ability for survival, which is reinforced by equal participation of all swarm members. In a swarm of bees, for example, the natural emergence of differentiation between drones, queens, and workers exists in harmony with the bees’ drive towards supporting the swarm’s continuity, its ongoing adaptation and fitness—qualities that crucially depend on the contribution of each and every single bee.

### 3. Harmonious resonance

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The swarm of thoughts and feelings that emerges and moves in one's mental space has the unique capacity of propagation from one individual to another—a capacity that can significantly increase, if the degree of criticality (degree of noise) in an organization reaches a certain level. Beyond this level is the area of the far-from-equilibrium organizational dynamics, which draw the organization towards the edge of chaos.

The conditions of criticality act as a powerful stimulator of people's willingness to share ideas and experience, to respond openly, to learn instantly, and even to help each other. Under criticality people can display unparalleled levels of creativity and resourcefulness. Behavioral patterns, which under conditions of order and equilibrium remain hidden or fuzzy, suddenly come to light—clear and transparent.

The “disclosing” effect of criticality is analogous to an effect known as *stochastic resonance* in signal transmission and pattern recognition: signals and patterns emerge much clearer, if their transmission is accompanied by a certain level of noise. The noise “harmoniously” resonates with the hidden or fuzzy boundaries of the transmitted signals and patterns and the contrast makes for easier identification. In the context of organizational dynamics, we shall refer to this phenomenon as *harmonious resonance in an organization*.

As far as the external complexity of the organization's environment is saturated with “noises” of various origin, and their internal complexity is constantly driven towards criticality (a process known as *self-organizing criticality* in complexity theory), the occurrence of harmonious resonance in organizations is quite probable.

When it happens, the swarming thoughts and feelings in the mental space of each individual spontaneously self-organize into coherent dynamic patterns, that is, patterns common for all the agents interacting in an organization. And suddenly a kind of magic occurs: the agents become able to act in sync and harmony, as if they are at-one—one multiagent entity, one multifacet unity, one inseparable whole—a flock of birds flying together with lightning speed.

Examples of such coherent patterns are:

- emergence of an organizational climate that stimulates agents towards realization of their skills and knowledge, towards learning and strengthening the “fitness” of the organization and its ability to evolve and grow;
- emergence of dynamically balanced (harmonious) interrelationships between the values and purposes of the individuals who work in an organization and the values and purposes of the organization as a whole.

Note that criticality is only a necessary condition for the emergence of harmonious resonance, but not a sufficient one. There are also other factors responsible for the actual occurrence of this kind of resonance in organizations. We explain this in detail in the sections that follow.

Harmonious resonance in an organization cannot be imposed—no swarm of thoughts and feelings in the mental space of an individual (with the ability to think and feel) can be forced to resonate according to somebody else's will. As far as the swarms are extremely sensitive to perturbations, it is the perturbations that can help in “tuning” the degree of criticality (edge-of-chaos behavior) in organizations so as to facilitate the emergence of harmonious resonance.

The skill for tuning criticality in an organization to a level capable of evoking coherent actions towards strengthening organizational fitness is of vital importance when managing organizational change at the edge of chaos.

#### **4. Effects of external perturbations**

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The external perturbations constantly bombarding an organization raises its level of criticality.

In organizational theory and practice, external perturbations are considered as something that impedes the development of an organization. It is assumed that if the external environment is kept quiet and predictable, organizations function much better than in a turbulent and unpredictable environment. As a consequence of such an assumption, a great amount of effort has been spent (and continues to be spent) on exploring how to avoid or minimize (neutralize) the effect of the perturbations. And the more energy spent in fighting with what are considered as disturbing organizational dynamics from “outside,” the less energy goes to an actual development of these dynamics from “inside.”

The environment can never be made to behave according to the preferences of the organizations (or their leaders); it is the organizations that need to learn how to “dance,” according to the rhythm of the environment, no matter how chaotic this rhythm appears.

What is necessary to emphasize is that although the external perturbations cannot be directly used for tuning organizational criticality, they are bearers of an immense energy. The question is: Can this seemingly disturbing energy be transformed into a creative energy supporting the fitness and growth of the organization from within, where the essence of the organization palpitates?

The essence of every organization consists of the individuals (agents) who build this organization through their dynamical relationships and make it evolve and grow through their competency, skills, and continuous activity.

To say that some external perturbations affect an organization means that they affect, above all, its *essence*—the agents who work in it. And it is these same agents who directly absorb the effects of the energy contained in the external perturbations.

At the moment of this absorption, a unique kind of transformation occurs. The energy contained in something that acts from outside of the organization, from its environment, transforms into energy of the agents acting from inside of the organization, from its very essence.

As far as the swarm of thoughts and feelings of people is extremely sensitive to any motion in the environment, the release of the energy of the external perturbations (through the effects which they have on the human dynamics) occurs almost immediately. And this energy then raises the level of criticality of the human dynamics, which are at the core of the overall organizational dynamics, and hence raises the level of criticality of the whole organization.

## 5. Awareness and learning

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The transformation of the energy contained in the perturbations bombarding the organization into levels of criticality of the entire organization can occur either unconsciously or consciously. In the first case, the agents are ignorant (or are deliberately held in ignorance) about the nature of the perturbations, their source, and power. In the second case, the agents make conscious efforts to understand (through their own experience, awareness, and learning) where the perturbations come from and how strong their consequences could be on the overall organizational activity. The depth of this understanding varies from individual to individual. Although both ways result in raising the level of criticality in the organization, the first way is usually accompanied with an ever-growing stress and tension in the agents' behavior, whereas the second way contributes to the growth of their knowledge and stimulates their creativity.

So, the question whether it is possible to transform the seemingly disturbing energy of the external perturbations into creative energies supporting organizational development can be answered positively, provided the agents do not blindly surrender to the external forces but constantly learn how to better understand their sources, their ever-changing nature, and their influences.

Any increase of the level of criticality in an organization caused by external perturbations provides unique opportunities for learning—just through a mindful observation of how the other agents react to perturbations of different nature and intensity, one can learn an enormous amount for adjusting one's own behavior. The greatest lesson, perhaps, is the lesson of *self-management*: how to manage oneself mentally and

emotionally, how to help and care about those who need support in order to cope with the growth of criticality, and how to motivate, energize, and inspire oneself, without waiting for stimulators from outside.

Critical organizational dynamics are impregnated with a huge number of possibilities for creative development, for strengthening the fitness, and accelerating the growth of the organization. If the organization (including its leaders) does not continually learn to see these possibilities, its survival is in danger. The chances for failure of an organization are directly proportional to the number of the failed-to-be-seen possibilities for its development—the greater this number, the higher the chance for failure.

## 6. Purpose as a strange attractor of agent dynamics

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Fortunately, the critical organizational dynamics are not only impregnated with the potential for emergence, they constantly realize this potential: criticality gives birth to strange attractors (or repellers)—emergent patterns of self-organizing energy.

As far as the activity of each agent working in an organization is purposeful, that is, oriented towards attainment of a certain goal or objective, the *purpose* can be considered as a focal dynamic pattern in an agent's mental space, which constantly attracts the swarm of the agent's thoughts and feelings. Without having any concrete material expression, this pattern informs, motivates, and inspires the actions of the agent, and therefore plays the role of a strange attractor able to expand, shrink, merge with other attractors, collapse, or “explode” into new dynamic patterns in the agent's mental space.

The purposes of the agents working in an organization crucially depend on their values, beliefs, and motivations (i.e., on a relatively stable basis, yet open for change and evolution) ideas which they hold as meaningful and true (inevitably colored with emotions and psychological response).

However complex and chaotic the dynamics of an organization, they are always pulled towards the purpose of this organization as a whole. The purpose of the organization propels—informs, motivates, and inspires—the whole rich spectrum of activities carried out by the organization, and reflects its mission statements, its strategies and visions about the future, as well as other (open or confidential, official or informal) organizational documents. The purpose of the organization plays the role of a strange attractor whose structure emerges as projections of the overall purpose of the organization on different levels (scales) of its functioning (divisions, departments, project teams, working groups, agents).

## 7. Harmonious resonance theorem

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Harmonious resonance in an organization occurs if and only if the agents' strange attractors representing their purposes are "tuned:"

1. in harmony with one another, and
2. in accord with the strange attractor of the overall purpose of the organization.

As far as the agents' purposes strongly relate to their values, beliefs, and motivations, condition 1 implies mutual willingness for collaboration, cooperation, and complementarity between the agents, rather than competition, obstruction, and conflicts.

Condition 2 requires that the overall purpose of the organization reflect the purposes of the agents, and *vice versa*: the purposes of the agents mirror the overall purpose of the organization.

The "accord" required by condition 2 does not imply sameness, the organizational and individual purposes do not need to be the same in order to be in harmony. Moreover, sameness is simply impossible, as the comparison is between two essentially different scales—characteristics at the organizational level differ from characteristics at the individual level. What is required is similarity, a similar kind of purpose. In chaos theory, the similarity at different scale levels has a special name, *fractals*.

In summary, the necessary and sufficient conditions for harmonious resonance to occur in an organization is an increase in criticality up to a level, beyond which the strange attractors representing the agents' purposes coalesce into an all-embracing fractal structure of one and only one strange attractor—the strange attractor corresponding to the overall purpose of the organization.

## 8. Incompatibility of harmonious resonance in organizations with profit-oriented attractors

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In today's run-by-money society, individual and organizational purposes are money-oriented. When the value of money is the highest object in societal life, most of the agents share the belief that the more money they can earn, the better they can organize their living; so the motivation to work is money-based and the purpose is to have more money. The thinking is similar at an organizational level—the higher the profit, the stronger the position of the organization; so the purpose is to increase profit.

The similarity in the relationship of the agents and their organizations to the flow of money meets condition 2 of the harmonious resonance theorem—there are fractal relationships (i.e., a cross-scale similarity) between the purposes of the agents and the organization.

Unfortunately, condition 1 of the harmonious resonance theorem cannot be satisfied when money is the dominant attractor for the agents and the organization. Instead of complementarity and collaboration, it is the competition and the pursuit for egoistic interests that are compatible both with the individual and with the organizational passion for profit. Financial alliances are possible, if and only if they strengthen the competitive capacity of the “collaborating” sides *vis-à-vis* their rivals.

As P. Bourdieu [4] explains, from markets where the organizations compete, the competition naturally extends to individuals themselves, “through the individualization of the wage relationship:

- establishment of individual performance objectives, individual performance evaluations, permanent evaluation,
- individual salary increases or granting of bonuses as a function of competence and of individual merit;
- individualized career paths;
- strategies of “delegating responsibility” tending to ensure the self-exploitation of staff who, simple wage labourers in relations of strong hierarchical dependence, are at the same time held responsible for their sales, their products, their branch, their store, etc. as though they were independent contractors. . .

In this way, a darwinian world emerges—it is the struggle of all against all at all levels of the hierarchy, which finds support through everyone clinging to their job and organization under conditions of insecurity, suffering, and stress.” [4]

## 9. Conclusion: Rhythm of self-realization

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Condition 1 of the harmonious resonance theorem can be satisfied with attractors of purpose that are out of the sphere of money. Stronger than the fever for money is the individual urge for self-realization; its creative capacity is boundless. If conditions in an organization stimulate this urge, there are no limits for both individual and organizational growth. When inspiration drives the swarms of thoughts and feelings of the agents, the organization becomes “robust” through finding its own rhythm of activity.

To find the rhythm of an organization means finding the “pulse” of its self-realization expressed as the pace of innovation (how often and when to change its production), of transition from one spectrum of activities to another, of entraining with other relevant organizations. It is a challenge for the managers and leaders to reveal the rhythm of self-realization of their organizations. Once revealed, this rhythm can be constantly energized through the urge for self-realization of each



and every agent in the organization. And, *vice versa*, the individual urge for self-organization can be stimulated by the rhythm of the whole organization, as the rhythm motivates people to

- do things simultaneously and in coherence
- have a clearer sense of changing priorities and different time horizons
- “fractalize” and pace their activity.

According to S. Brown and K. Eisenhardt [5], the rhythm also helps for:

- synchronizing the organization of complex tasks
- giving people a way to pace their own work
- enhancing confidence building
- driving a time pace that other organizations end up following.

The rhythm of self-realization keeps the organization directly connected with the very core of its human dynamics, where the swarm of people’s thoughts and feelings never ceases to pulsate. And it is exactly through the pulsation of this swarm—through the rhythms of our brainwaves and heartbeats reflected in our capacity to think and feel, that we aspire to grasp the rhythm of life and nature.

## References

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