AN EVOLUTIONARY IDEA OF EVOLUTION: A PEIRCEAN INTERPRETATION OF A HYBRID-AGENT ORGANIZATION MODEL

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Abstract

This paper proposes an evolutionary interpretation of a hybrid-agent organization model. Charles S. Peirce's conception of evolution, a combination in some Darwinian and Lamarckian ideas, is a key component of the development of such systems trying to cope with evolving data provided by an evolving environment. In Peirce's conception of evolution, we find at its core the concepts of chance, natural selection, continuity, habit, and harmony. By using those Peircean concepts, we claim that this process of evolution is found in information systems belonging to hybrid-agent organization models in financial organizations.

1. Introdution

An evolutionary interpretation of hybrid-agent organization modelling could be quite diverse. In this paper, we propose a new evolutionary interpretation of a hybrid-agent organization model. Charles S. Peirce's conception of evolution, a combination of some Darwinian and Lamarckian ideas, is a key component of the development of such systems, trying to cope with evolving data provided by an evolving environment. In his ideas of evolution, Peirce was rather a theorizer and a systematizer of the main evolutionary ideas of his time.

The paper starts, in Section 2, by briefly surveying the concepts involved in Peirce' s idea of evolution, such as chance, natural selection, continuity, habit and harmony. Section 3 discusses, and presents an example of the evolution of programs belonging to hybrid-agent organization modelling in financial organizations. Section 4 presents the concluding remarks.

2. Peirce's conception of evolution

Peirce's idea of evolution [8] has some characteristics that are similar to those ascribed to the idea of evolution by the main thinkers in the 19th century, that is, namely by Darwin and Lamarck [2], [3]. Although Peirce's conception of evolution changed in time, he always conceived it as involving growth, consistent and continuous. Even though Peirce's conception of evolution is not scientific *per se*, he pays attention to the scientific results related to evolution as a confirmation of his views. Peirce, as evidence supporting his ideas, has used these results on evolution in many of his manuscripts [7]. During the 19th century, the word "evolution" was closely related to progress, and it was commonly applied to specific instances of organic evolution, which meant that only living things evolve. For Peirce, instead, not only the organic, but also the physical realm, evolves according to scientific laws.

The most important Darwinian theory of evolution, according to Mayr, that Peirce accepted too, is the theory of natural selection. [8] It dealt with the mechanism of selecting the most suitable examples, and more particularly how this mechanism could account for the seeming harmony and adaptation of the organic world.

For Peirce, *chance* (i.e., the balancing entry of natural selection) was one of the first elements he found in the theory of evolution. He believed that chance was primarily the way things happen in the universe. It is related to probability. [7] Peirce said that Darwin's theory of evolution could be considered as an application of the statistical method to biology. Peirce says that wherever there are large numbers of objects having a tendency to retain certain characteristics unaltered, this tendency, not being absolute, gives room to chance variation. Peirce maintained that chance in evolution is related to novelty. Evolutionary chance, for Peirce, meant that

all things in the whole universe could be in another way. This is a fortuitous situation in a specific place at a given time. This concept explains diversification of beings and their environment. The second idea associated to chance was the concept of *natural selection*, which accounts for the reduction of variety implying that the more fitted will survive. These two concepts, which in the 19th century were related to "progress", nowadays are connected to applications to specific instances of transmutation as well as to the process of change in general.

The third concept in Peirce's idea of evolution is *continuity*. He struggled for many years, to arrive at an accurate mathematical definition of continuity. In 1889, he was partially satisfied with Cantor's definition of continuity. [1] G. Cantor said that continuity is the perfect concatenation of a system of points [1]. Peirce thought that evolution, not only in the biological realm, but also in the whole universe, is a continuous process that never stops tending, in a nonmonotonic way, to improve in the long run.

Peirce took *habit* from Lamarck's *Philosophie Zoologique* [3], the fourth concept in his explanation of evolution. All things in what we call reality have the influence of a particular environment. Animals responded to environmental changes by developing new habits that can be inherited by their offspring. Peirce accepted Lamarck's remark that the necessary conditions necessary for the existence of life are present in the lowest organization, and they are here reduced to their simplest expressions. From this principle, Peirce could explain that irresistible propensity of all things in the universe (including humans) to make associations and generalizations. Even in very primitive animals, that do not have human intelligence, the tendency of actions can never be the product of a reasoned choice or judgement or experience. Their actions are controlled by an inner feeling and by habit.

Finally, in the idea of Peircean evolution, we have the concept of *harmony*. He means by it a combination of parts into a proportionate or orderly whole. In that harmony we find as a principal characteristic of the evolutionary process a maximum self-consistency. The whole universe, and nature as part of it, is supposed to be underlined by a pre-arranged constancy and harmony. The harmony of one state, at a given time, is the sum of other sub-states that have self- consistency among their parts as well.

In Peirce's idea of evolution, these five concepts are indissolubly tied together. This is an on-going process. It never stops. (See Figure 1)

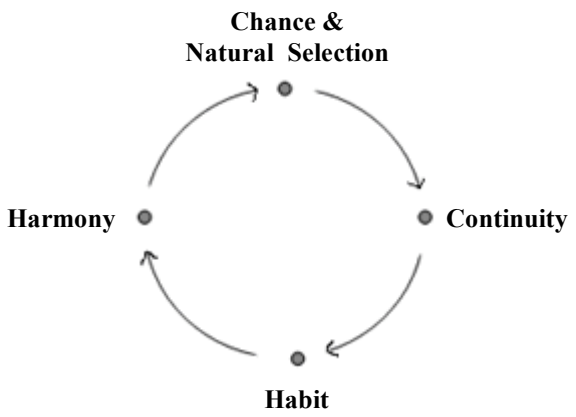

Figure 1. The on-going process of evolution

3. Evolution of information systems in an organization

A hybrid-agent organization model can be understood as a frame for the structure of an organization. Our organization modeling tries to capture, in a flexible way, the main part of an organization used by a team of hybrid-agents to satisfy their goals.

From a logical-heuristic point of view, the organization model *M* is an ordered set comprising an *environment* or domain, *hybrid agents* as elements of the environmental structure, and *some connecting functions* between the agents and the environment. Formally, we have:

M = (environment, hybrid agent, function).

By using a hybrid-agent organization modeling, where the *hybrid-agent* may be composed by a *heuristic-decision support system* (HDSS) and the *decision-maker* as a unit, we can provide instruments to help when making decisions in a financial organization such as a commercial bank [4].

We claim that, in financial organizations, models and the corresponding algorithms related to them evolve according to the Peircean idea of evolution. First, let us consider evolutionary *chance*. In any particular perception of the organizational reality (i.e., environment), there are always an infinite number of overlooked facts. This *chance* is related to probabilities. This is because there exists a certain organizational situation, which is a product of external factors that are random at a given time. When we start

the development of an information system in general, and a HDSS in particular, there are certain variables that are only relevant at that particular time (i.e., they make a *natural selection*). Those variables determine the system development.

In order to exemplify what is the process generating this chance performed by this particular type of hybrid-agent organization modelling, (which includes the user as a part of the heuristic system), let us present a basic algorithm for *chance*:

I. Chance

1. Present A1 as the first algorithm among an infinite number to solve a given problem of the organization
2. For x=2, 3 … n do

Select a new algorithm as Ax

IF Ax is the same type of A1

Accept Ax as a correct algorithm

End if

If the number of corrects algorithm is enough for the posterior natural selection

End

End if

3. Next

II. Natural Selection (Backtracking Version)

To determine the natural selection of algorithms A do the following:

1. Select B as the actual algorithm in the organization
2. Select A1 as the fist algorithm of the chance group
3. For k = 1,2,…,n do

IF A_k is an improvement of B with respect to the needs of the organization

Set Ak as the new B algorithm

End if

Next

4. Select B as the new algorithm for the organization
5. End

For the next natural selection, this algorithm starts again.

The third element of a Peircean idea of evolution related to algorithms in a hybrid-agent organization modelling is the idea of *continuity* (i.e., continuous growth) of models and the algorithms in decision support systems in an organization (e.g., a commercial bank). Given any set of facts of certain financial aspects of reality in a financial organization at a given time, we can always find an algorithm that deals with these aspects of reality. Every process related to this reality has a continuous growth even though this growth is nonmonotonic. To be nonmonotonic in this context means that experts in information systems present new algorithms based on the partial information they obtain on the evolving environment at a given time. This is why, many times they must correct the algorithm when they obtain more information that is accurate later on.

A basic algorithm for *continuity* could be the following:

III. Continuity

1. Analyze the new set of facts in the organization at a given time
2. Find an algorithm accounting for those facts
3. IF the algorithm is appropriate for the organization
   a. Use the algorithm
   b. End

Endif

4. Goto step 2

Habit is the fourth element in our reconstruction of Peirce's idea of evolution. Habit in this context, means that any algorithm can be associated to other algorithm in order to perform better tasks. There is a tendency to generalize and adapt algorithms to an evolving environment. The processes and models evolve, too. Moreover, in this evolution they try to adapt themselves to the reality of that evolution. The information systems and their models try to conform to the reality of the organization.

The basic algorithm of these generalizations (*habits*) could be as follows:

IV. Habit

1. Analyze an existing algorithm partially solving a problem
2. Find other algorithms partially solving the same problem
3. Combine all algorithms in a single one
4. IF the resulting combination better suit the needs of the organization

Use the algorithm

End

Endif

5. Goto step 2

Finally, the last concept involved in our idea of evolution is *harmony*. The main characteristic of an evolutionary model in information systems is self-consistency. In reality, all facts have a tendency to equilibrium. In organizations, the adaptation of the parts to the whole has an internal equilibrium (i.e., a

self-consistency). Everything in an organization (i.e., persons, processes, procedures, software, organizational culture, etc.) has this tendency to a self-equilibrium. In information systems, all the processes must have that internal harmony. Besides, the system has to be in external harmony with other systems. Those systems could be information systems or not. In addition, the systems must act in *harmony* with the user and with the laws of the country.

The basic algorithm for this requirement may be:

V. Harmony

1. Find an algorithm
2. Analyze each part of the algorithm
3. IF the parts are self-consistent
    a. If the algorithm is consistent with the needs of the organization and the environment
        Use the algorithm
        End

Endif

4. Discharge the algorithm
5. Select another algorithm
6. Goto step 2

4. Concluding remarks

In this paper, we present an evolutionary interpretation of a hybrid-agent organization modelling. This evolutionary idea of evolution is founded in Peirce's idea of evolution. This conception includes not only chance but natural selection, continuity, habit and harmony, as well. We analyse those concepts as they are presented in decision support systems. Some basic algorithms and rules for those concepts are presented in this essay as examples of how they work on information systems. Decision-makers in a financial organization are human entities, and therefore, their minds evolve according to the Peircean concept of evolution as well.

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