

Obsolescence of Organizations: a Modeling Approach in System Dynamics

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Abstract

Economic crisis as well as human crisis is well alive. Bankruptcy filings, the collapse of financial/capital markets, strategy failures, the death of some organizations accuse the turbulent economic environment. But what about their potential activities, their internal capacities that change over time. It is unfortunate that some literature areas dealing with the decline of organizations focus on their disease at a specific time by giving importance to factors related to age, size and performance. This is wrong to underestimate the evolutionary aspect of tangible and above all intangible resources. The purpose of this communication is to highlight that before the decline and death of an organization, there is a preliminary stage, often misperceived: the obsolescence. Obsolescence defines a condition that prevents the organization to perform correctly its vital functions and that without her being fully conscious. Our model of system dynamics has the primarily objective of defining the state of obsolescence and secondly to highlight the importance of two strongly linked subsystems meaning: organizational capacity and managerial ability. These two dimensions, coupled together, are often misidentified or misunderstood by the top management, whereas they may be able to characterize and anticipate an emergency situation.

Keywords Managerial Capacity; Organizational Capacity; Dynamics; Obsolescence; Model; System

1 Why, what field and what subject for this research?

1.1 Why this study

Our past experience has led us to lead a group of “SME”, to straighten firms in distress as a senior consultant and, many years, to conceptualize these achievements with a thesis PhD at the Sorbonne in the field of organizations dynamics (evolution and change of state). It was during this career and after in becoming a full Faculty member and Researcher that we often asked ourselves some questions about the future of organizations.

The sole ambition of this study is to identify and teach the concept of obsolescence as a general phenomenon often unknown for executives and managers of the company. Yet it is a step often announcing the decline or disappearance of the organization. Our research on the phenomenon of obsolescence is trying to reach an understanding which is not limited to specific cases, but that is applicable

across time and space and to different types of organization.

1.2 The research question

Is there a persistent step which would herald the decline and death of organizations? What would this step? Is it possible to identify the precursor weak signals of the organization collapse?

Can we model this prior step announcing disaster? While there are many researches on organizations mortality, yet few qualitative studies have been conducted about symptoms often considered marginal, but harbingers of economic and social tragedy. Because the model is based on concepts such as the organizational capacity or the managerial capacity (cognitive factors) it belongs to qualitative areas. We then discard ourselves from quantitative parameters such as the age of the organization, of the staff, the size, the strength of the company that abound in the studies.

1.3 The problem

The above questions can be synthesized by the finding and the question that follows, giving rise to thought and discussion:

Some organizations becoming mature lock themselves increasingly into their adaptations and are pushed inexorably such "lava", unable to change course, heralding a likely senescence index. Therefore, how to spot early enough the gradual slowing of vital functions of an organization? What are the warning signs?

To address this problem, we will define semantically the concepts of complex organization, organizational capacity and obsolescence. Then we will depict the literature on our research field. Finally we will present our model, the methodology underlying it and results of simulations will be debated during the "discussion" which will close this presentation.

2 Definitions and foundations of the model on the obsolescence

2.1 Organization

This is an intangible concept. For the organization is a myth[1], "it exists only events linked by causal loops" that creates meaning ('sense-making'). It is the interactions between the components of the organization that create a coherent and stable set. It is also a system of collective problem solving. In this spirit, the organization is the product of the choices of leaders and of their social representation. This collaborative system attempts to combine, to arrange the components of the work to be done to achieve the best organizational capacity, concept we will define below.

Organizations move, change over time¹. The uncontrolled change creates asym-

¹This topic has previously been the subject of dynamic simulations. Cumenal D[3,4].

metry, disrupts the harmony and curbs the progression of the organization. This one changes shape both structurally and in terms of the functional organization due to its history, its environment, internal resources and its management. Thus, we enter in a field named “dynamics of organizations”. We think we can characterize this one by different stages:

A conservative state where the weight of history, customs of the past pushes the organization to inertia despite active economic context; an adaptive state due to the pressure of the environment causing the competitive intelligence, to imitation; a cooperative state characterized by the maintenance of cohesion, the desire to avoid conflicts, the development of inter-organizational networks; Finally, a state called progressing state which is defined by the desire to innovate and operate the organizational inimitable assets. Of course, these states may be overlapped or juxtaposed. To move from one state to another, there is always energy dissipation, a cost of change.

2.2 The organizational capacity

The end of 20th century saw the development of a school of thought based on organizational resources and on organizational skills named Resource Based View. Organizational capacity is defined as a collective ability.

We explain that the performance of the company benefits from a human capital (knowledge, skills) but also from a good organizational architecture (optimized process, formal and informal network of relations and communications, etc.) and from technologies. Thus, the results can be explained by the presence of intangible resources shared by the players in the organization, but also difficult to imitate by competitors.

According to Laurent and Gilles Renard E St-Amant “The concept of organizational capacity defines the ability or the skill of the organization to deliver activities with efficiency and effectively in deploying, combining and coordinating its resources and its expertise across various processes creating value, depending on the objectives defined previously [2].”

2.3 The definition of obsolescence

From “obsoletum”, “to fall into disuse”, in Latin, the obsolescence reflects a behavior, an processing that is no more adapted to needs, to current and desired methods and to changing desired by the management . It turns out, over time, by slowing the functions and vital activities of the company (the unsuitable routines and processes business and support, etc.).

The behaviors, the actions of an organization are no longer adapted to environmental change because the processes, routines, professional reflexes that have developed during the learning have become rigid or unable to agree to new situations.

Symptoms of obsolescence are often veiled, because they grow moderately over

time. For example, a product loses slowly market share; a business process is becoming more expensive and less efficient than a new process developed by competitors; staff engagement in the Business of the company gradually becomes weak; the indifference of the staff for customers is becoming more marked; the leaders do not move in order to avoid a changes; information flows less and less. In general the reactions are increasingly inadequate and unsuitable for external events and circumstances.

3 Literature review

Existing approaches for understanding the decline and death of organizations are fertile, although empirical studies on the spot are leaner. However, works on the obsolescence are not common and do not define properly the concept.

Seventy five percent of the literature on the decline of the firm were written during the last decade of the 20th century.

We can mention books and papers by David A. Whetten and Kim S. Cameron, authoritative on the subject of decay and mortality of the organizations[5][6].

Most recently, Yitzhak Samuel describes in his book, models for predicting bankruptcy[7]. It also addresses the age, size and niche factors, performance and even corruption. Stewart Thornhill and Raphael Amit in an article named "Bankruptcy, Firm Age, and the Resource-Based View conducted a literature review on organizational mortality[8]. Through the number of publications, it is clear for many researchers, that the age of the organization is a critical factor in mortality. However, Stewart Thornhill and Amit Raphael, Learning , establish that the firms failure is also caused by a lack of managerial knowledge and in general by the lack of tangible and intangible resources (such as skills and organizational capacity)[9]. These firms are often paralyzed by a change in their environment.

Barry M. Staw, Lance E. Sandelands, Jane E. Dutton show how organizational rigidity evolves faced with a challenge[10]. Faced with a threatening environment, the organization tends to respond based on past experience deemed relevant, but unfortunately inappropriate given the new circumstances. Moreover, in an urgent and tense situation, policymakers can hide certain information by discarding solutions they consider abnormal with regard to the opinions and beliefs of the group they belong to. Somehow, filtered information must be in resonance with the unique thought of the Leaders!

Erik Larsen and Alessandro Lami operate a systems dynamics model by demonstrating how the causal relationships and feedbacks between variables, simulate over time, evolution of organizations inertia[11]. These authors show the opposition between resistance to change and the ability of organizations to develop new capacities to generate performance. The model, rather schematic is, according to

these authors, based on ecological theories and evolution of organizations. Inertia is mentioned and briefly explained by the following factors: size, age, cumulative experience. Figure 1 shows their model. It will be seen that size is correlated with age, which is an exogenous (external) variable to the system.

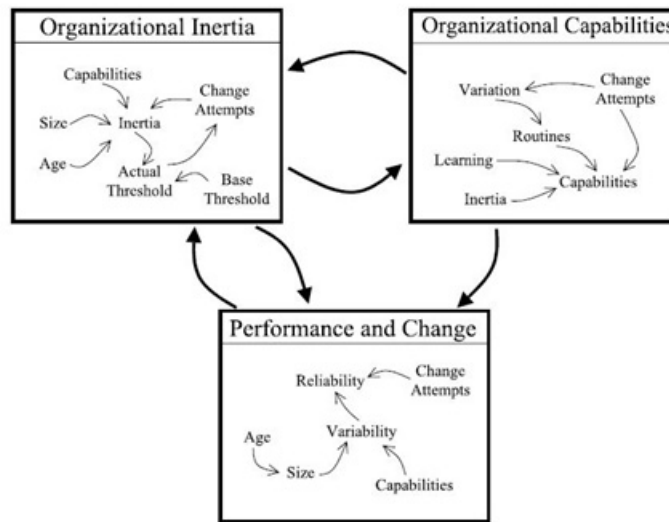


Fig.1 the organization evolution model

4 Model

4.1 Methodology

The model we have developed is not intended to generate assumptions to be tested. It seeks to show the stages of evolution of an organization to explain the causes of obsolescence thereof. It is therefore not limited to analyze each step separately considered. Our model generates situations, rather than describing them. It strives to provide an pedagogical insight into the obsolescence onset. The model aims to study the evolution of organizational behavior and to identify early signs of wear and the weakening of main functions and activities of the organization.

Our approach is keyed on systems dynamics that studies how things, objects evolve and change state over time. John D Sterman , in his book“Business Dynamics ”, sets principles² of this approach[12] The approach is structured around the concept of causal network that establishes a cognitive diagram highlighting structural feedback loops. These are the relationships between the variables that

²For a criticism of the system dynamics, we carefully read the book by David Berlinski[12].

explain the system behavior over time, and not the system parameters considered separately. System dynamics highlights the counter-intuitive effects in the medium and long term, related to decisions taken in the short term, taking into account the effects of random events that can occur within, or in the environment of, the system.

The model breaks down the system in state variables (reservoir) and flow variables (transit rules from one state to another). Delayed effects and adjustment time are integrated into the model structure. The model uses numerical algorithms to produce simulated results. We can present the results as time series plots and measure the sensitivity of a variable to evolution of other one.

System dynamics can be modeled using a set of equations with that standard form:

$$x(t + \nabla t) = x(t) + x(t) \bullet \nabla t \quad (1)$$

in which is the model integration time step. However, the choice of value greatly influences the results of the numerical simulation as shown with the three graphs below (Figure 2 : the population development; time on x-axis and quantities on y-axis). Clearly, there are analytical solutions, but as soon as the model becomes complex, it is difficult to solve the equations in a conventional way.

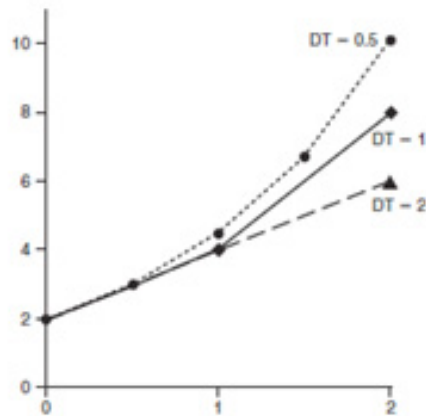


Fig.2 the population development

We will simulate our organization over several years to observe the evolution of the properties that characterize obsolescence. But for that, and before its use, we must expose the assumptions that characterize the structure of the model.

4.2 The causal structure of the model

Our model is structured into two subsystems or two causal diagrams:

- 1) the organizational capacity (C.0),
- 2) the cognitive ability of management (CCM).

The following properties are not included in our model, voluntarily: age of the organization, age and size of staff. These attributes are often considered by the authors as exogenous variables. We believe that there is not necessarily a correlation between size and age of the firm, for example. Likewise, these variables influence very little the inertia of the organization as we think sometimes. Rather, we focus on capabilities of the organization, i.e. the potential³ and cognitive factors of the “top management” that ensure organizational transformation. It is the hypothesis that we assume.

4.3 The causal diagram of organizational capacity

We defined above the organizational capacity. We modeled it (see Figure 3) using the following properties:

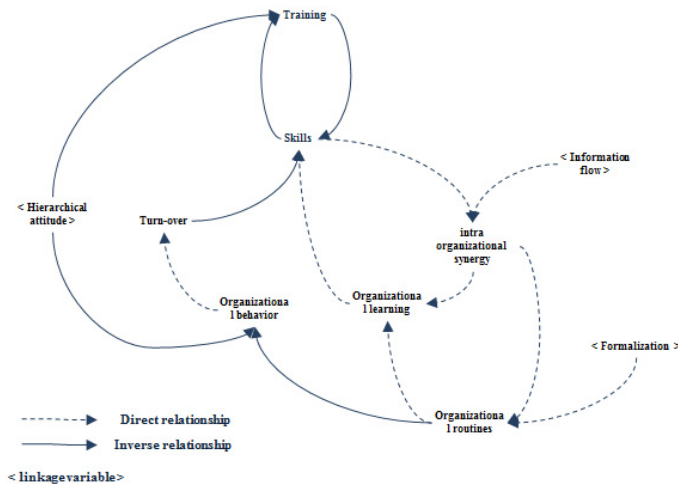


Fig.3 Organizational capacity causal diagram (O.C.)

-organizational learning⁴ i.e. collective acquisition of skills by recurrent actions,

-the skills produced by both organizational learning and training

Croutines⁵ built and distributed by internal collaboration within the orga-

³Tangible and intangible resources provide the firm a competitive benefit.

⁴For a study on organizational learning, reference may be made to Argyris, C[14].

⁵Routines represent individual and collective, repetitive work habits which may be driven by operational capitalized modes.

nization - the flow of information and communication that contribute to this synergy between actors.

This causal diagram shows many feedback loops that explain the results that we will comment during the presentation of results and discussion.

For example, the more the widely disseminated (and unfiltered) information in the organization, the more it contributes through exchanges, to enhance coordination between employees or vice versa (direct relationship). On the other hand, the more the turnover is increasing, the more organizational skills⁶ are diminishing, due to departures and overall impact the organizational capacity.

4.4 *The causal diagram of the managerial capacity*

Collective rationalization is a cognitive process of sorting and selection of information, but this process also products resonance, answers already learned, as consistent with prevailing views in the firm. This mental state generates a collective logic that justify the decisions. Necessarily wanting to be in agreement with the “others”, and especially with the “Top management”, can be a powerful engine of collective errors.

This rationalization taken to the extreme, leads to a denial, an occultation of the environment, filtering of information, but also a refusal to take a look on the past and on current state of the organization. The strategic blindness with unrealistic goals, can lead the entire organization to a thought, a single depiction. We have, unfortunately, observed this fact many times when a Department persists in its judgment error. Therefore excess of hierarchical pressure (the authority) was included as a variable in our model. Beyond a pressure threshold, it acts to discipline, to structure responses of the organization. There is a “Mahatma” effect by which governance behaves as a spiritual leader! Its possible that problem could be identified, but the illusion that what we’ve always done is the best thing, trumps reality, generating actions that may be the wrong answers. Our model in Figure 4, below, reflects this divergence of representation with a gap that symbolizes a “cognitive dissonance”⁷. With the latter, the information, leading indicators of entrepreneurial tragedy are ignored because they are too discordant with the successes until recently. The intensity of this difference is as important to the overall performance⁸ of the organization. Moreover, poor re-

⁶Organizational skills are generally depicted as coordination of resources and capacity[15]. They are linked to an accumulated experience (organizational learning).

⁷Pioneered the concept of cognitive dissonance is Leon Festinger. According to this theory, when events lead a person or organization to act at odds with his beliefs, these acts produce a state of discomfort and tension called dissonance. To reduce this condition, the person or organization is allowed to exculpate himself by constructing an argument near a deception! And management can persist in his error justifying its decisions and actions despite the good sense of “field” [16].

⁸We define the concept of performance as a business development index value created by taking into account the quality of the responses of the “top management” facing a problem.

sults reinforce hierarchical control by systematically operating (routines) modes, but also impacting organizational agents behavior of the organization, themselves sensitive to performance.

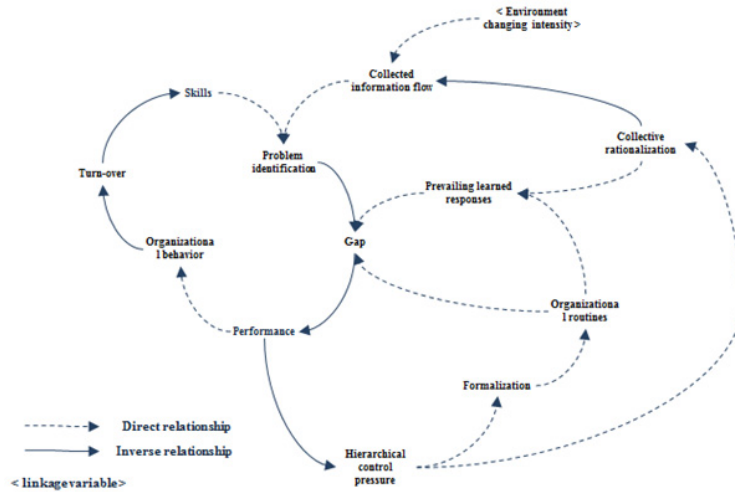


Fig.4 Managerial capacity causal diagram (M.C.)

4.5 Results and behavior of the model

It is interesting to study properties of all variables only on a qualitatively basis. We focused on the behavior, i.e. on shape of the curves rather than looking numerical values hard to estimate when the concepts of organizational and managerial capacity is mentioned. The range of variation of each variable extends for most of them from 0 (minimum) to 1 (maximum). It corresponds to the assumptions, and common sense “on the ground”. For instance, increased internal information filtering reduces synergy, knowledge sharing or informal⁹ kills formal knowledge and consequently performance.

The simulation performed using a system dynamics software (Stella, from Isee Systems, V.10.0.6) produces a typical organization behavior over a period of 10 years. You can of course change the duration of the simulation. Watching graphical patterns on Charts : 5, 6 and 7, we note a performance in sharp decrease. The diagnosis of the curves shows a slowdown in performance from grade 8 (curve 4 in Chart 1 below) and then decreased. It can be seen also from the sixth year a slowdown in the level of organizational skills (curve 3), that of organizational routines¹⁰ (curve 5) and finally a breathlessness of organizational learning (curve 1). These are state variables which gradually accumulate flows acting as drivers

⁹It is, for example, short circuits in the official channels of communication in the organization.

¹⁰As a reminder, the routine reflects the regularity of collective behavior induced by procedures.

of change over time. Chart 2 below shows a bad fit between dominant and learned responses that are an expression of “Top Management” thought and timely responses (curve 2) produced by the community in light of the problems identified. The gap persists for many several years, peaking in the third year of the firm. Then, the two curves are similar from grade 6¹¹ to deviate from each other the 7th grade. We believe this difference is a revealing leading indicator of future performance degradation. Finally, it takes place in companies when some people say that top management persists in his error by maintaining an axis of inappropriate development.

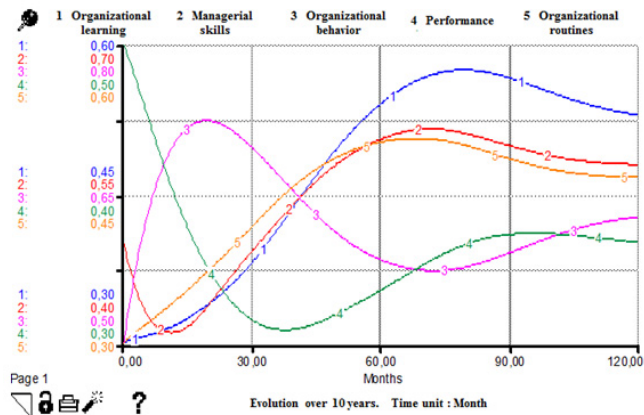


Chart1

However, the entire management team adopts this guided behavior and looking for one or several arguments to justify their position according to the cognitive dissonance theory, which we mentioned earlier.

The chart 3 bellow, analyzes several behaviors: The impact of information filtering (curve 1), the degree of formalization and rationalization of the weighted procedures organization (curve 2) and intra-organizational synergy (curve 3). The latter also depends on the information that flows and the level of technical and managerial skills move through the organization.

These are also indicators revealing symptoms which anticipate possible resources shortage and organization’s capabilities. Actually, we hear, for example, that information does not flow, or the procedures are too heavy, reducing more and more autonomy in the work of each.

¹¹Is this rapprochement leads to the reason?

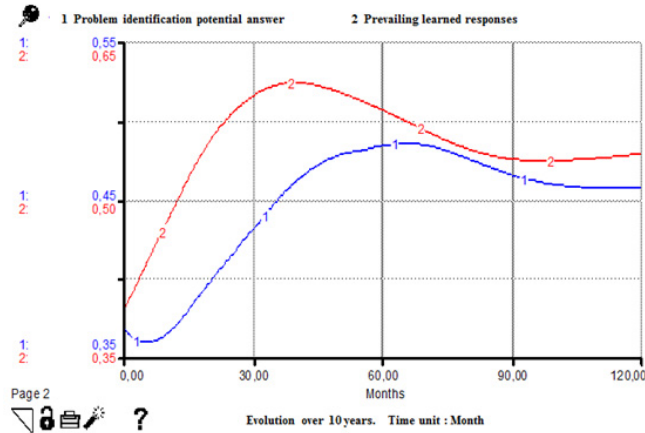


Chart 2

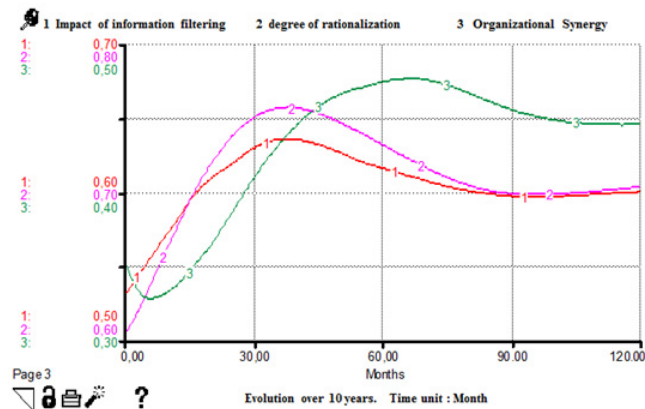


Chart 3

5 Discussion and conclusion

Our model consists of five stock variables¹²(levels) corresponding to five integrations or state equations described as follows:

$$E(t_k) = E(t_j) + \int_{t_j}^{t_k} [input(t) - output(t)]dt \tag{2}$$

$E(t_k)$ = thestateatktime.

$E(t_j)$ = thestateatpreviousjtime. ($j = k - 1$)

$\sum_{t_j}^{t_k}$ = algebraic sum of inputs and outputs between t time and t time + increment time step DT. Inputs and outputs over time depends on “auxiliary

¹²Skills-learning-behavior-routine sand performance variables that have been previously defined.

variables” that changes according to causality with other variables (stocks, flows or auxiliaries). Auxiliary variables are expressed with mathematical functions often based on non-linear correlations. Our systemic model is built on feedback processes with, often, a delay between cause and effect.

Our model can help us to understand the emergent properties of the obsolescence and to analyze the results of an a concept not easily accessible through statistical interpretations of reality. We support the following proposal: analysis of organizational capacity and of managerial ability, i.e. symbolic representations and the answers given by the leaders facing a problem, can anticipate a resources and vital functions slowdown of the organization. We did not cover theories that emphasize the organizations ecology (size, age, etc.) to help us focus on intangible properties. Of these ,we may recall the important role of learning and organizational skills, filtering and retention of information, the coordination and collaboration process(organizational synergy), collective rationalization of responses from the leaders giving the illusion that what they do is the best thing (further reinforced by the weight routines or past habits).

The simulations show that weakly filtered information combined with a normal hierarchical pressure (more or less) can achieve a good level of performance. In this case, the staff has the opportunity to provide possible answers to the context. Obviously, these responses are determined by the skills level and by the received or perceived information quality. Censorship or a bad collection of information weakens staff responses and strengthens, conversely, the traditional answers provided by the “Top Management”. These are related to the rationalization of produced responses and to the organizational routines that capitalize collective behaviors generated by the procedures and by the taken decisions. In the latter situation, the operational process integrates finally the dominant responses produced by the “Top Management”, in finding good reasons to accept (see the concept of “cognitive dissonance”).

Our simulation explain the importance of the gap between the collective responses learned by staff and dominant responses supplied by the “Top Management”. This gap is an important performance gear.

5.1 Model limitations

We may recall the important role of learning and organizational skills, filtering and retention of information, the coordination an collaboration process (organizational synergy), collective rationalization of responses from the leaders giving the illusion that what they do is the best thing (the rest reinforced by the routines weight or the habits of past).

The dynamics systems’ mathematics is widely used in physics. However, social sciences resist using them.

Indeed, formalize mathematically organizational behavior is very optimistic!

The model quickly becomes a black box for an external observer who wants understanding the results produced (non-linearity is one of the reasons).

Another limit is the validation of the model. We don't have neither historical nor quantitative data about concepts presented. As we have previously stated: our model is more generative than descriptive of existing situations. It suggests events and behaviors. It allows us to anticipate, and to have a better understanding.

In conclusion, we have been always convinced that an organization gets its best performance when the representations of a problem, the supplied answers, aims of employees and those of top management are similar.

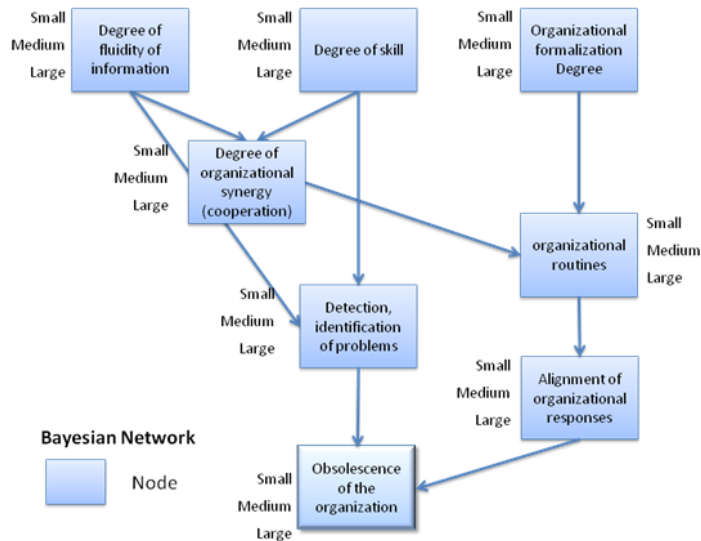


Fig.5 Bayesian model outline

When societies and civilizations are becoming complex and prosperous, they have difficulty adapting to their environment. Their potential assets appear to be inadequate to move to their next evolution stage.

5.2 The potential model evolution

We are currently developing a Bayesian network based model (Figure 5) to anticipate the phenomenon of obsolescence. We intend to test this tool on several professional situations. The result will be the topic of a future communication.

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