

SIMULATING ORGANIZATIONAL CHANGE: MOVING AND SHAKING

*"Fugit irreparabile tempus"*¹

Didier CUMENAL

PhD - University Paris I Sorbonne

Director of research ²

ISC PARIS Institute of Management

22, Boulevard du Fort de Vaux – 75848 Paris CEDEX 17 – France

+33 1 40 53 99 99

dcumenal@groupeisc.com

Associate Professor ESCM School of Business and Management

Abstract:

We still know very little about the long-term learning patterns of organizations. Analysis tends to favor the more immediate factors over more distant ones. We focus on synchronic portrayals of the organization while ignoring diachronic representations.

The model presented here analyzes changes in the state of the organization over time. It describes and investigates the totality of forces and actions that generate the organization's dynamic. It offers a speeded-up aging of the organization intended to bring out the counter-intuitive effects of decisions over time. Moreover, it endeavors to identify the "cost drivers" that contribute to increasing or shrinking the firm's profits.

The organization can be represented by a time-based mathematics (differential equations) that simulates a "chrono-organization". The model was built by using the concepts of systems dynamics. It was developed on a computer, using Vensim DSS32 software (Ventana Systems, Inc.).

The meta-model that was developed is used to derive an application model whose purpose is to reproduce the long-term life of an organization. The simulation speeds up the aging of the organization, enabling the user 1) to show the counter-intuitive effects of decisions over the long term versus the short term, and 2) to highlight the cost drivers that generate hidden costs. Through its decisions, the firm gives rise to its own factors of development and decline: its own actions eventually change both the organization's health and its properties.

The model's purpose is to provide a better understanding of this evolution and of the dynamics of the changing state of the organization's components over time.

Keywords:

modeling – decision – simulation – cost drivers – system – organization – potential – state – functional order – structure – infrastructure – superstructure – flux – temporal extension – time – property – historicity – circular causality – holism – dynamics – force – action – meta-model – change – development – form – feedback loop – accumulation – task – supervision area – organizational capacity – innovative capacity – diachronic – synchronic dialectical – routine – learning

¹ Time flies relentlessly

² Former Associate Professor Panthéon Assas University, Paris 2, France and Compiegne Technology University, France

Introduction

Significance of the subject – Research concept

We still know very little about the long-term learning patterns of organizations. We often over-emphasize synchronic³ representations of the organization. When looking for causal explanations we tend to favor the more immediate factors, while overlooking the more distant ones. Longitudinal models that take time into account when analyzing the dynamics of an organization are very scarce. Nevertheless, every organizational system possesses a temporal dimension. Like Alain Eraly (1988), I believe that the historicity of organizations has been neglected in the construction of purely rationalist, functionalist models. Jean Louis Lemoigne (1984) found that any organizational system could be broken down into three sub-systems: management – information – operator. In this presentation, I attempt to structure the process of organizational development according to the principle of temporal extension. For this purpose I identify three levels of extension over time, depending on their greater or lesser degree of stability when confronting the forces of change.

How are we to comprehend the organization and its dynamic?

It is not my intention here to present a systematic review of all the theories of the organization: for that the reader should consult Jacques Rojot (2003), who has provided a very complete European discussion of the subject.

I should first of all make it clear that I take the opposite view from those who emphasize the pressure of context. Thus, Lawrence and Lorsch (1967) offer a model of the organization that depends on its environment; it adapts by incorporating or differentiating its activities. This is the structural contingency theory. Similarly, the theory of external control of the organization by the environment leads to the organizational ecology of Michael T. Hannan and John Freeman (1989). In contrast to these views, I am more interested in the "organizing" action. The idea of K. Weick (1995) is also my own: the organization is a myth, "there are only events connected by 'sensemaking' links of causality".

All institutions organize themselves by creating their own interactions and rules; the organization is driven by its internal forces and acts upon the environment.

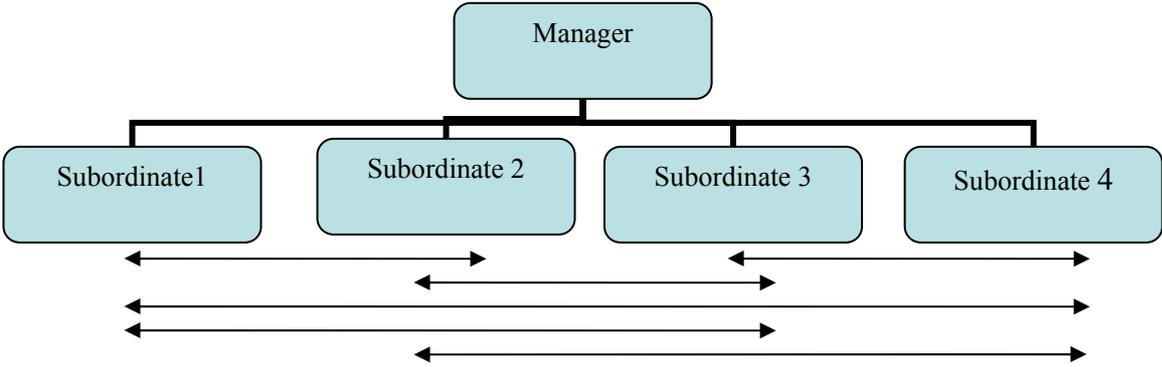
Thus in my view, organization is a matter of bringing together and combining all the items that comprise the work to be performed, so as to obtain the best possible optimization or value. It also involves allocating the best resources to the activities. According to S. P. Robbins (2000) "the organization is an economic unit having identifiable borders, and functioning in a relatively continuous fashion, in order to reach an objective or a set of objectives shared by its participating members".

It is the interactions between the organization's constituents that create a cohesive, stable whole, i.e., "the organized". In the opinion of G. Chauvet (1998) these interactions or associations form a potential or reservoir of combinations of possible states (this concept resembles the variety required by Ashby, 1958). Although the organization presents a large number of hierarchic levels and thus a high functional order (greater specialization of tasks and activities), the number of interactions and associations tends towards zero. Thus, a flattened structure defined by its manager and the manager's 14 subordinates (i.e., two

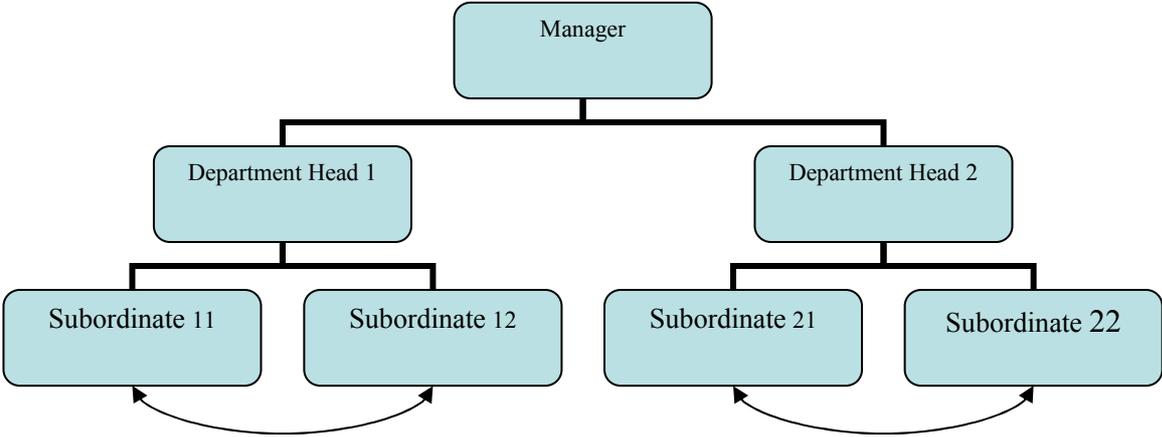
³ synchronic : a process that occurs at one time only, and is therefore not repeated, as opposed to the diachronic, which expresses continuation and alteration over time.

hierarchical levels and a supervision area of 14 colleagues) will have a low functional order but a very large number of interactions (14 x 13 interactions). A structure with 15 persons in four hierarchical levels, and a management or supervision area of two colleagues, will have a high functional order but a low organization potential (two interactions per work group).

This can be illustrated by an example and the following diagram. In the first organization chart below (two hierarchical levels and a supervision area of four) the number of horizontal interactions is greater than in the second organization chart (three hierarchical levels and an average staffing area of two colleagues). In the first case, the potential is higher than in the second. The possibilities for cooperation are greater, but the functional order (specialization) is more limited than in the second diagram.



The organization potential (ability to self-organize) depends on the number of interactions between components



A higher functional order expresses a greater division of labor (narrow range of subordination). Although work groups are more stable in this situation, owing to closer coordination, on the other hand properties of the organization such as the free flow of communications and the speed of decision-making will be checked.

The Problem

Area studied - aims – questions

The only purposes of the model constructed here are:

- 1) to understand the development and the dynamics of changes in the state of the organization's components over time. For example, after a learning period a salaried employee hired as a beginner becomes a professional. A young (*ad hoc*) organization may later become a bureaucratic or professional organization.
- 2) to connect costs to the forces and pressures that give rise to them, in order to identify the cost drivers.

*Once again, note that the model developed here is not intended to generate theories to be confirmed, but rather to contribute to understanding by constructing possible states with the potential to evolve, instead of just analyzing the states or situations that are observed. This model is thus **more generative** than merely descriptive of existing situations.*

As stated previously, organizations must be comprehended in the context of time. Our paradigm⁴ is in fact historicity.

According to W. H. Starbuck (1976) "An organization does not move automatically as if it were a compact core of all its activities (at the same time), it tends to separate into fragments that move at different speeds". I employ this theory of "fragmented cores" to explain resistance to change and the impact on performance. The model and the computer simulation based on it attempt to present a morphogenesis⁵ of the organization.

We will inquire into the nature of the internal organizing forces. Are there organizational threshold effects, breaking points, or deferred disasters that explain, over time, the rise and fall of performance?

The Model

Options - Theoretical basis – Conceptualization approach

Remember that any model is a simplified and approximate representation of reality that is based, in the present case, on a particularly concise and formalized language (mathematics). The strength of a model rests on its intelligibility regarding situations that are characterized by ease of interpretation and by a proper understanding of the results that it produces. Models have an illustrative role in thinking about a system.

To construct this model I have borrowed the concept of decreasing temporalities from Fernand Braudel (1990), who describes History as a temporal extension at multiple levels: long term, current situation, and an event at the present moment.

⁴ paradigm: commonly held belief that enables the explanation of a phenomenon by analogy to the functioning of an object such as a clock, and the mechanistic conception of the universe.

⁵ morphogenesis: distortion of the organization in the course of time, under the impact of decisions and actions.

Theoretical Basis:

This model is based on a structural dimension. I agree with Giddens (1987) that a structure contains the action that produced it, or perhaps as Morin's Method says, that the whole reacts upon the whole and on its parts, which in their turn react by reinforcing the whole. All societies organize themselves by creating their own laws and rules, i.e., their own interactions. We may see the organization as a dynamic system of loops. The organizing forces are internal to the system itself.

The factors of internal development, as D. Robey (1986) said, have an impact on organizational growth. For example, changes in the internal characteristics of an organization such as a drop in motivation, a weakening of skills, the growing complexity of information systems, an increase in hierarchic levels, more lengthy and cumbersome control procedures, superfluous activities, and so on, generate hidden costs. This deterioration in the characteristics or the properties of the organization is what we call a "cost driver".

This simulation is based on a series of differential equations, or more precisely on equations with finite differences. Thus the organization's development draws on a time-based mathematics.

The sum (or \int *actions* (the accumulation over time) produces organizational forms and represents the organizational metamorphoses of the organization.

The system presents variables of state (the accumulation variable at a given moment) and variables of flux between two moments, whose effects may be more or less delayed. The equations with finite differences can be written:

$$Level_{t+1} = Level_t + dt * (Rate / Rate_Delayed)$$

$$Rate = \frac{dx}{dt} = \sum input - \sum output$$

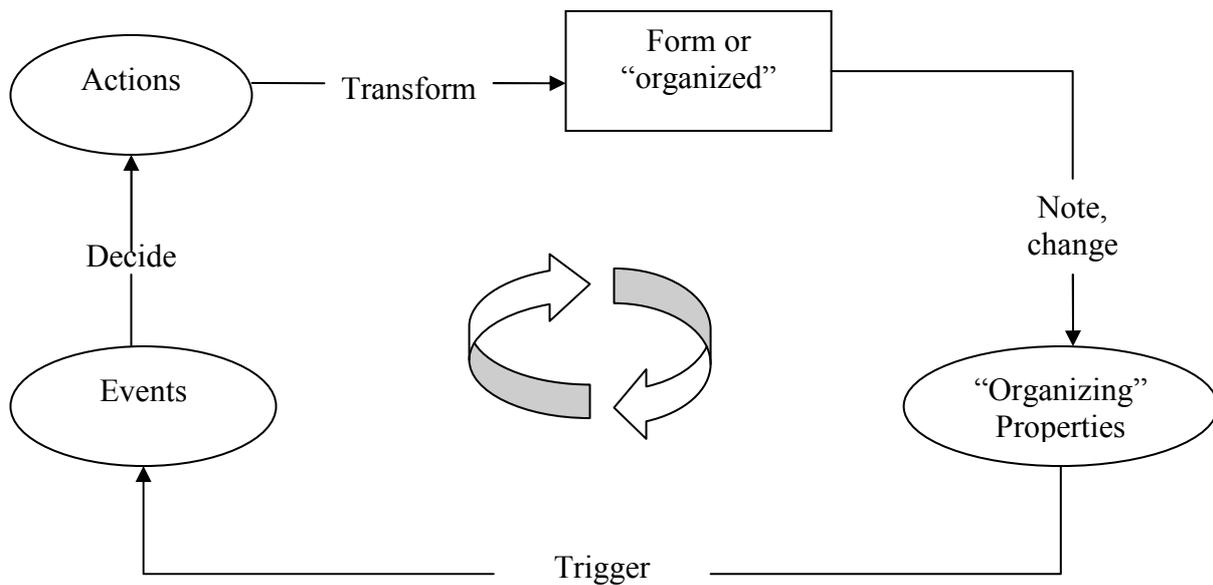
$$Rate_Delayed = Delay3(Rate)$$

the notion of a dynamical system includes the following ingredients : a phase space "S" (possible states of the system); time "t" and an evolution rule that allows determination of the state at time "t_n" from the knowledge of the states at all previous times. The state at time t₀ allows determination of the state at any time t > t₀

A time delay always occurs between taking an action and seeing the result of this action. The delays or lag times in models can produce counterintuitive results.

Based on the classification of H. Starbuck (1976) this is a metamorphic model that leaves room for non-linear phenomena, regulation loops, breaks, and rapid, unexpected adjustments.

- The Meta-model⁶



Meta-model concepts

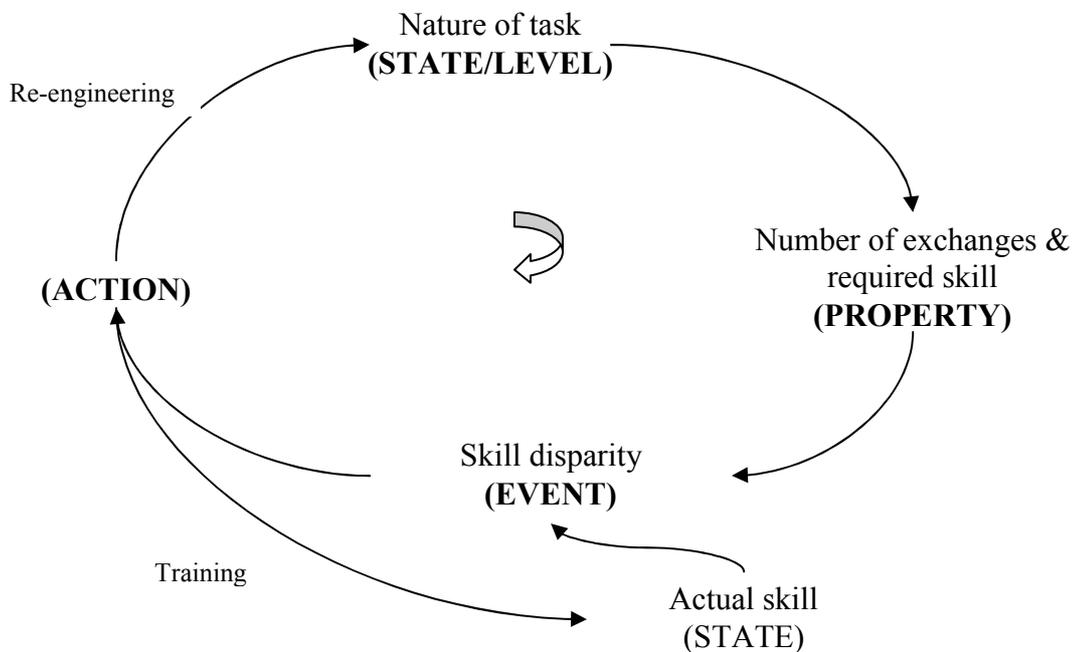
Dynamic

A state is the accumulation of forces and actions that act on an organization at a given moment (example of a state: the hierarchic structure and its associated area of supervision, the organizational routines or tasks, the overall skill of the personnel, the reward system, the social climate expressed in working relationships, the degree of formalization connected to procedures, etc.). The forces that act on these states are the actions performed between two moments in time (e.g., new recruiting, personnel departures, re-engineering of tasks, creation of new regulations, etc).

The properties shared by organizations are the consequences of states, or the changing of a state. These properties represent the behavior of the state. These are themselves subject to the influence of the forces and actions that they exercise. Quantitative variations lead to qualitative changes (property). For example, a change in temperature generates a solid, liquid, gaz state. In the system dynamics thanks to variables such as lookups, properties can be represented. The following are examples of properties: qualification, motivation, the flow of an information system, the organization's degree of rigidity or formalization.

⁶ meta-model: model that describes the components of the modeling in a way that allows us to understand the models derived from it. Criteria that characterize the meta-model: genericity (derived models) – semantic unity: same context in all the models – independent of the context

The causal diagram below shows that the tasks that have become most comprehensive in scope (by reassembling) require the broadest exchanges in teamwork, and consequently demand higher skills. This then triggers an event (skill disparity) that requires new actions such as either a new re-engineering of the work, or a training initiative to raise the level of actual skill.



In addition, the appendix includes an example of the evolution of bank organization, from Norbert Alter (2003). I have used the meta-model to provide a dynamic representation of the three successive periods (1960/70 – 1980 – 1990) that are characterized by the three states: bureaucratic – ad hoc – professional

According to J.L. Lemoigne, any system may be broken down into three sub-systems: management – information – operator or operational. In my opinion we are creatures of time, and the development of a system may be characterized by its temporal extension. I propose three levels of decreasing temporalities:

Infrastructure:

This is the core of the organization, though not by any means an invariant, since it develops slowly over five to ten years (major temporal extension). It comprises a construction process in which the organization's properties are memorized by means of regular, repetitive processes (e.g., socialization and acculturation, routine or recurrent activities). It is characterized by the division of labor, the nature of the tasks (such as specialized or multi-purpose), the coordination processes, the dominating or power relationships, personnel status, compensation system, values, etc.

This stable core is the very foundation of the organization. I am in agreement with the theory advanced by Nelson and Winter (1982) under which, for quick decision-making, one should seek out and rely upon the most appropriate and most effective organizational routines. Standardization, even rigidity, does not produce inefficiency, quite the contrary. For scholars of evolution like Nelson and Winter (1982), learning is cumulative, based on knowledge

gained during earlier periods; organizational routines acquired by employees in the course of their interactions give meaning and consistency to the decisions taken.

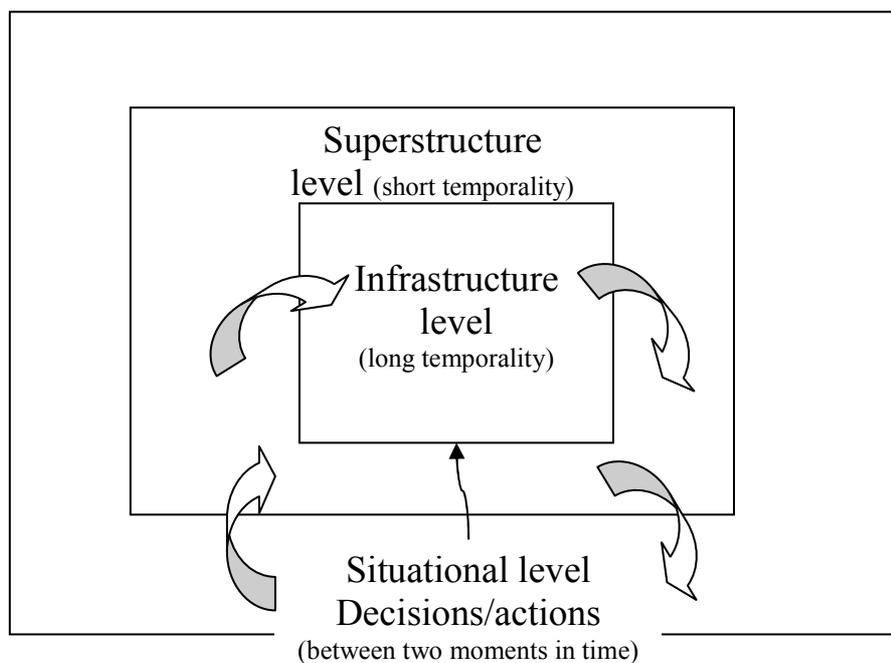
Superstructure:

This comprises all the artificial and technical systems created by man, such as accounting and management control systems, the information system, methods and procedures, the processes of innovation and research, etc. This base develops more rapidly than the foundations that characterize the infrastructure. It is typified by phenomena that evolve more quickly (temporal extension of one to five years).

Situational level :

This is the level of decisions (day-to-day, weekly, monthly) resulting from events observed in the organization, such as performance and profits. These decisions trigger management and organizational acts that regularly impact upon the superstructure level, but sometimes on the infrastructure level as well. Dyschronias or desynchronization may arise from the confrontation of these two layers, leading to counter-intuitive performances over time.

The following diagram illustrates these three levels:



We can make a preliminary observation: the rates of change in the three levels may become desynchronized over time.

Can these different tempos of development set off breaks or organizational mutations?

How can we seek congruence between these three levels, so as to manage change and improve performance?

A decision is not an isolated act but rather a process that has counter-intuitive consequences and effects over time.

How can we make the best decision, taking into account the different speeds of adaptation and reaction?

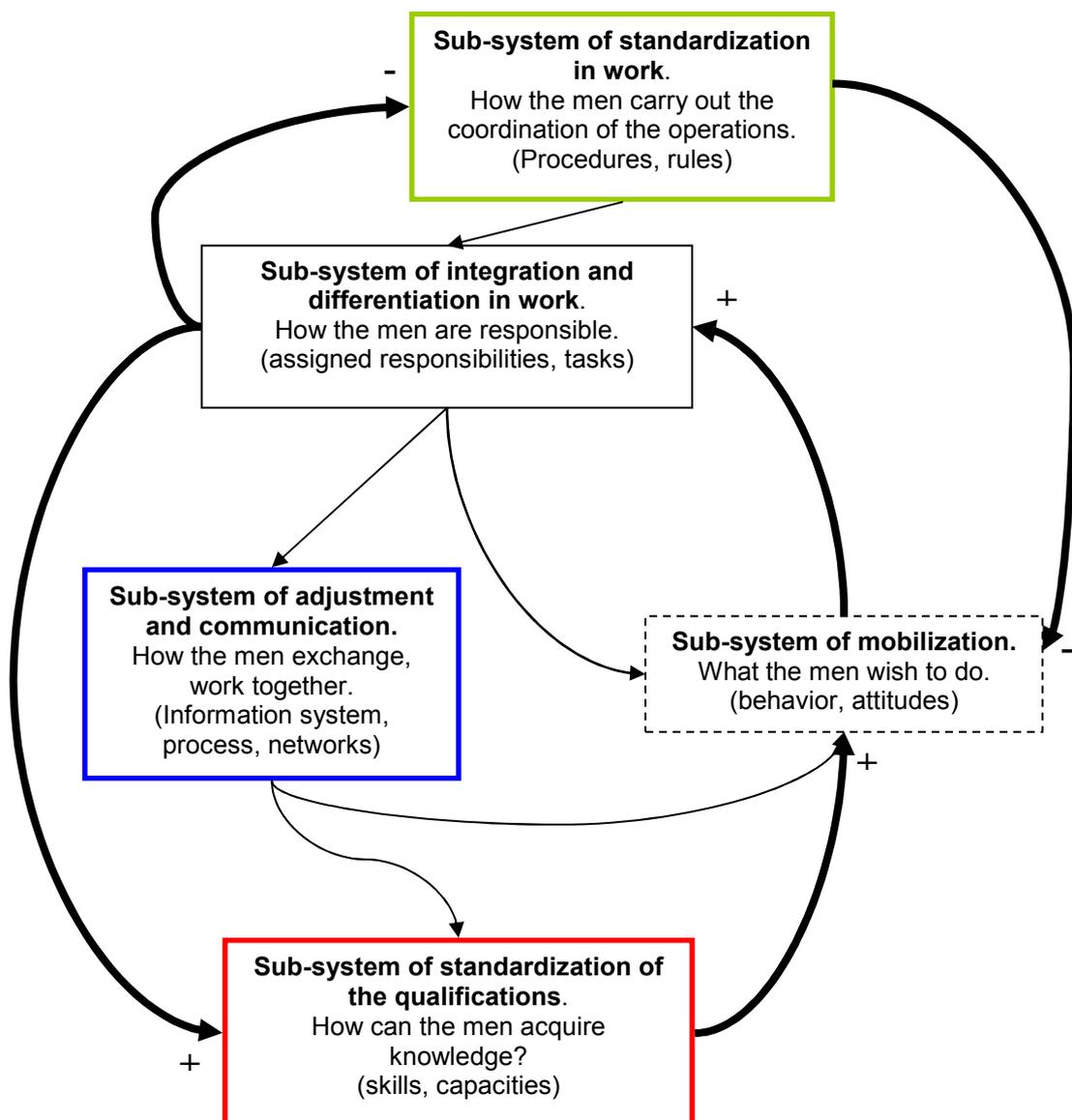
I have refined the representation by using the meta-model to derive a dynamic model of the organization that describes it in the form of causal diagrams (feedback loops).

- The operational model

The model was established and simulated on the Vensim software, version 5.2c. It includes nearly 650 variables and constants (including 91 lookups, 71 levels).

I will deal with the 3 levels of analyse stemming from the meta-model (see above) introducing first a structure made of 5 sub-systems, then a global causal diagram (a more macroscopic description) and last a detailed causal diagram. Thus I'll start from general point of view and then move to top-down approach.

➤ *The structure of the model broken up into five sub-systems*



Each system contains variables of infrastructure, of superstructure which move according to different scales' of time. The dark arrows represent the total causal diagram (macro level) which follows.

More integration of the tasks is important (macro-task, multi-purpose) more skills and asked capacities increase. Moreover coordination in work requires more formal rules of synchronization to arbitrate a parcellized work. In addition the behavior of the men is influenced by the degree of formalization or standardization of work (creation of the rules) as to that of acquired knowledge which must be adjusted with the skills required by the nature of the assigned tasks.

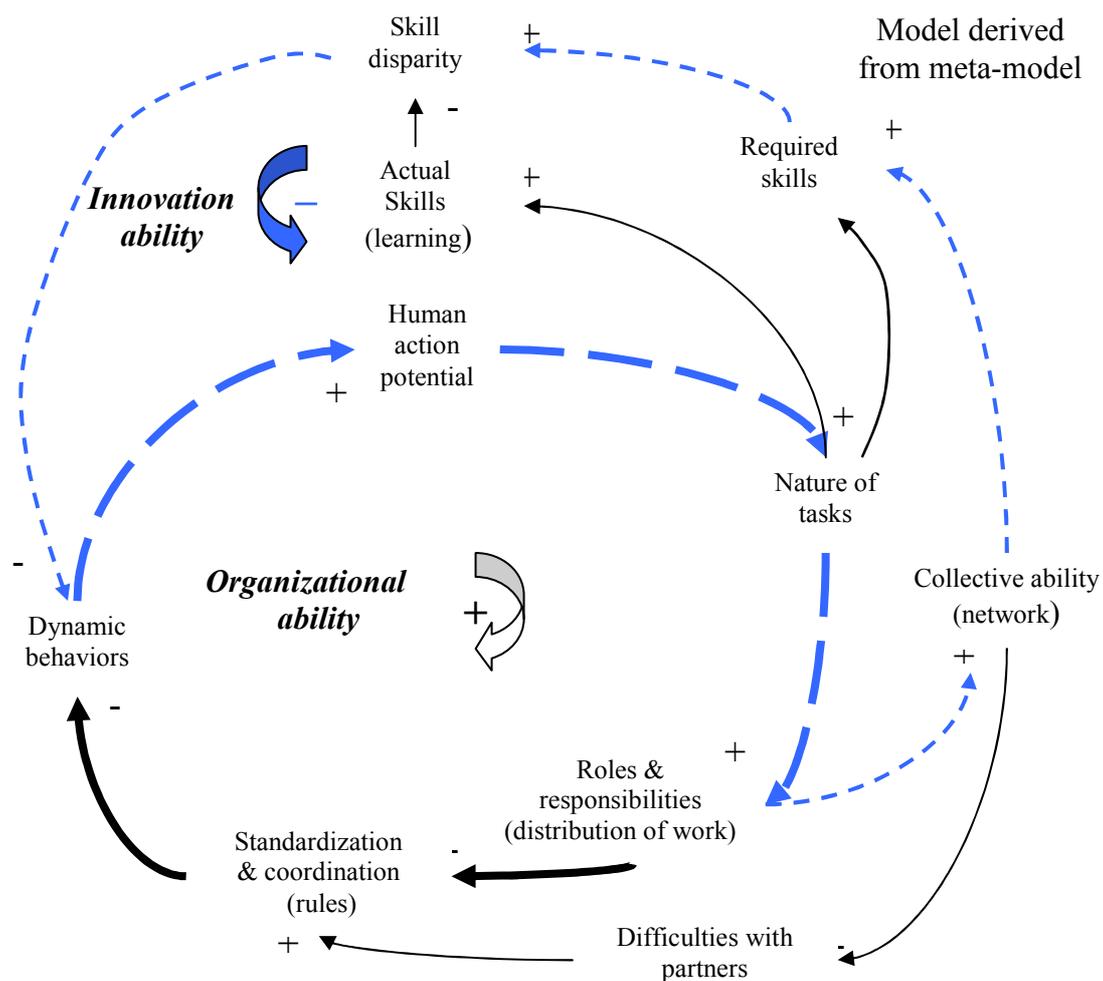
The responsibilities and the roles assigned to the men are related to their dynamics (attitude) to integrate or reject the work which is required of them.

➤ *The total causal diagram (macroscopic level)*

The nature of the tasks (differentiated, integrated) defines the roles and responsibilities. The tasks require a more or less large degree of coordination (property). The amplitude of the margin of freedom (degree of standardization=property) generates a dynamic or static behaviour. The behaviour triggers human resources of actions to achieve the tasks.

Moreover the complexity of the tasks determines the level of qualification required (System of standardization of the qualifications). The skills and the capacities adapted to the situation trigger motivation in work.

I developed some parts of the model and I integrated the concept of network or working group (communities of interest):



The model's essential variables are defined below:

Collective capacity (network): coupling between occupations and communities of interest (degree of interaction between salaried employees and organization partners). This is a kind of "collective" or multilateral arrangement of managers, engineers, and partner organizations, more or less interdependent in nature. It can be represented quantitatively by the number of interactions taking place between the actors and partners in the organization.

Behaviors: logical behavior of salaried employees, determined by the intensity of the motivation and of the tension or conflict existing between them. We distinguish "stimulation/response" behavior from that characterized by the "actors/creators" model. Colleagues are not made to collaborate by setting bureaucratic rules, but rather by appropriate dynamic attitudes and managerial skills (M. Crozier).

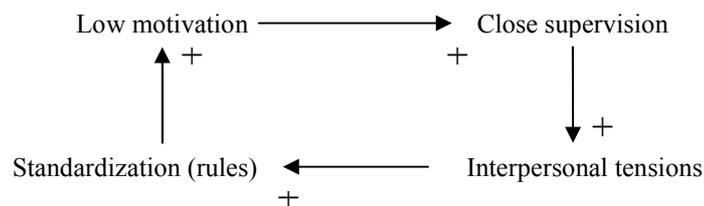
Nature of tasks: set of operations, either differentiated (specialization) or grouped (individual multi-purpose or team multi-purpose). Production tasks tend to become enriched (+) or impoverished (-) by a decrease or increase in the operations that comprise them.

Human potential: all the attitudes and abilities that make possible a work dynamic, such as the capacity for action, or the capacity for taking initiatives.

Standardization and coordination by means of rules: errors in quality, interpersonal tensions, and horizontal and especially hierarchic coupling tend to increase the weight of management and organizational procedures.

Skills: accumulated resources of expertise (knowledge) and inter-personal skills (attitudes). Skills increase with experience acquired inside the company, but also as a result of personal attitudes (in particular, strong motivation and pro-active behavior).

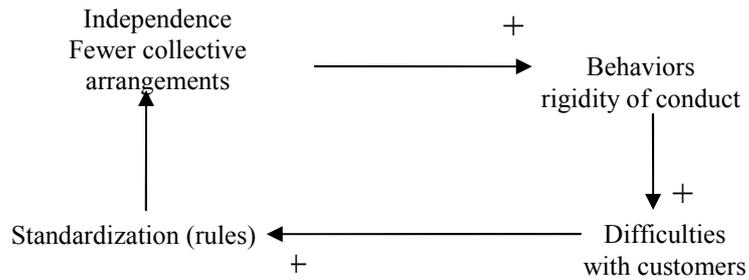
The premises for the model are taken from the diagram by A. W. Gouldner (1964):



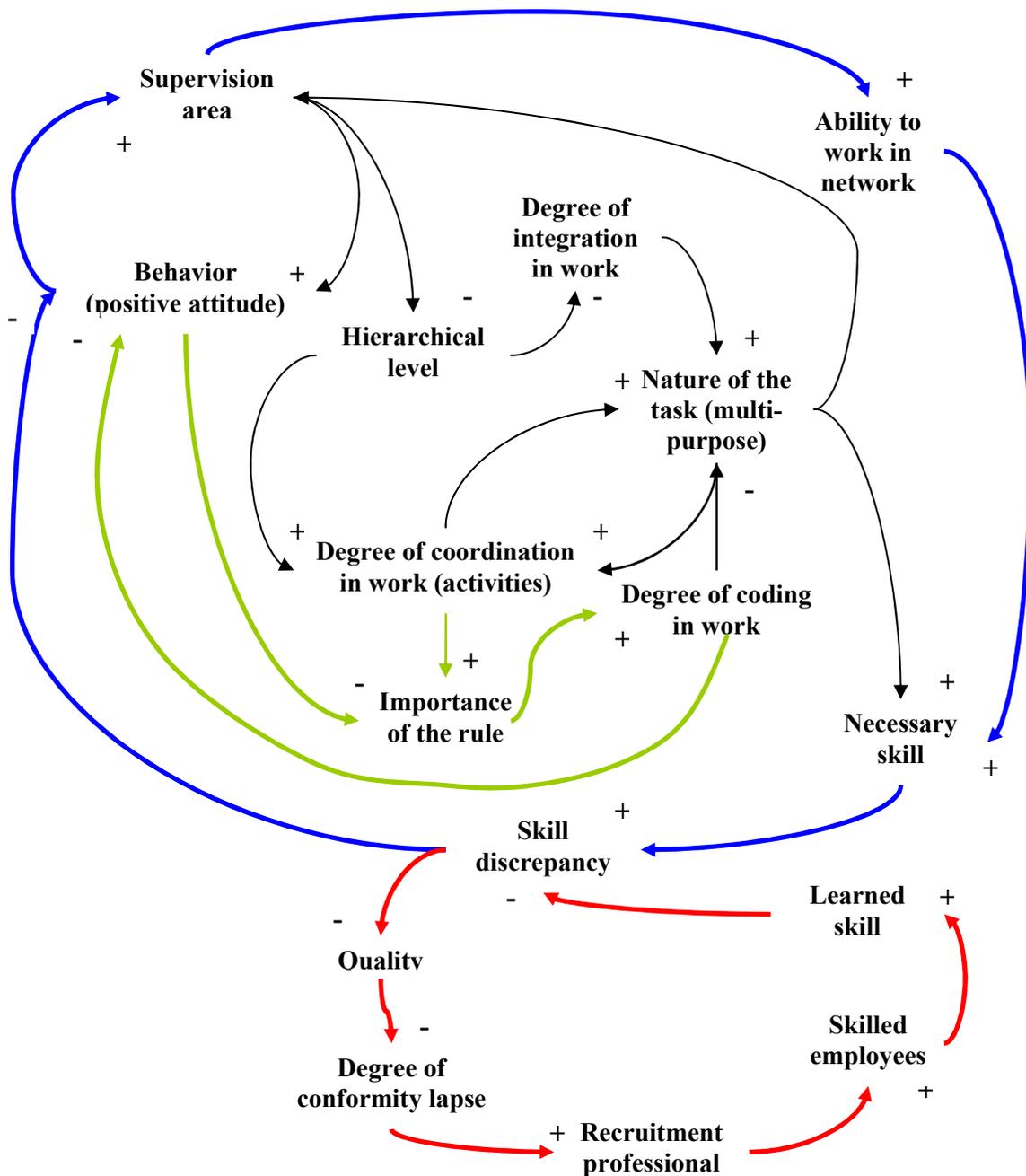
An increase in the standardization of work by the rules implies a fall of the motivation which triggers a control more strict of the personnel by management. This direct supervision creates tensions which are then arbitrated by rules.

I also recommend another theory, presented by R. K. Merton, which I have supplemented by the concept of organizational innovation. This theory goes as follows:

The importance of standardization (management and organizational rules) causes rigidity in the behavior of salaried employees, leading to a reduced capacity to work as part of a network or community of interest. This in turn leads to a distancing, and to service problems with customers. Now, it is the partner network, i.e., openness to other people, that enables an improvement in skills that are increasingly diversified and specialized, but closely complementary.



➤ The detailed causal diagram of a subset of the model



The causal diagram above integrates some properties like the degree of coordination

(adjustment of work between several actors), the degree of integration or differentiation for the tasks and activities, the degree of coding, the degree of conformity lapse.

The significant changes of these properties regarded as events, generate actions of organization (reorganization of the tasks, creation of new rules) or operations of management like the recruitment of professionals.

Necessary skill in work depends on the nature of the assigned task (specialization, multi-purpose) and is related to the managerial capacity work in network.

The supervision area corresponds to the number of employees framed by their manager. The average supervision area determines the hierarchical depth. For example, the organisational configuration describing a person in charge supervising fourteen subordinates creates two hierarchical levels logically.

But if there are two subordinated by person in charge, one obtains four hierarchical levels with same manpower (fourteen plus the person in charge).

The attitudes (passive, dynamic) in work are subjected to the more or less strong degree of coding or standardization of the organization which acts on the margin of freedom of the actors. But the behavior is also influenced by the discrepancy on skill. The insufficiency of qualification (under-qualification) or on the contrary the over-qualified worker influences the motivation. Appendix 2: “discrepancies between the target organization and its actual results » described these differences.

The rule is necessary when it is a question of coordinating parcellized tasks and also to arbitrate conflicts

The supervision area is influenced by the attitudes or behavior of the personnel. If the employees miss dynamism or of implication in work, the person in charge must control the daily tasks of his collaborators involving a loss of energy and conflicts. For this reason one designates Middle Management in charge who must frame with more close the personnel and withdraw with the Top Management the operational tasks.

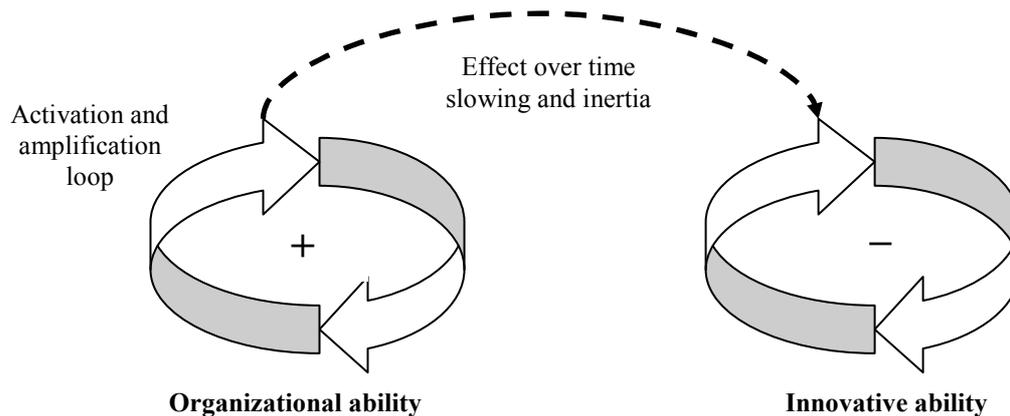
In the same way a weak initiative in the assigned responsibilities request a stronger rationalization for work obtained by rules which mitigate this insufficient autonomy by formalizing the procedures of work.

The dual capacities of the organizational model.

The global causal diagram above, derived from the meta-model, may be broken down into feedback loops in which each circular causality creates a self-sufficient domain, providing direction and unity. In this way we can observe a first loop defined by the following circuit: tasks (specialization... multi-purpose) → roles and responsibilities (area of supervision) → standardization → behaviors → human potential (abilities and attitudes) → nature of the task, which expresses *the organizational capacity for reducing uncertainty and ambiguity, and thus for optimizing performance.*

Moreover we can also imagine a second loop (dotted): tasks → roles and responsibilities → collective ability (working in a team or network) → required skills → skill disparity → behaviors → human action potential (efficient, motivated labor) representing *the innovative ability to profit from uncertainty and thereby to develop the organization.*

So in any organization we have two opposing force fields: a first network of causalities that tends to formalize and standardize the organization so as to reduce uncertainties and organizational vagueness, and a second one that pushes organizations to innovate by profiting from the areas of uncertainty and the skills acquired while working, and obtained from the network. However, between the short term and the long term there are latent counter-intuitive effects. In fact, they show that organizational ability (diagram below) reveals a growing standardization of the organization, once a threshold has been passed. Over time it may bring about a slowing of the capacity for innovation.



Two feedback loops: organizational ability and innovative ability

Appendix: "3 the model: rising and brakes " illustrates the dual capacities of the organizational model

But this opposition between organisational ability and Innovative ability can constitute a dialectical unit, which forms only one concept, that of the organisational innovation. This dialectical unit is created through interactions between several sub-systems and variables which dilute or dissolve in the same unit the oppositions. It is necessary to exceed contradictions, the too simple dichotomy between the cause and the effect, by dialectically thinking the relationship between causalities (Lucien Sève, 2005), and more particularly the relationship between causalities through time.

It is one of the principal axes of the nonlinear systems dynamic which is opposed to the reductionism.

Conclusion: First results from the Model

The model is expressed and simulated in formal fashion by equations with finite differences, using the dynamic "Vensim" software from Ventana Systems Inc. The appendix includes several screenshots.

The simulation enabled confirmation of a decision's counter-intuitive effects over time, produced by discrepancies existing between certain properties of the organization, such as the skill required for new tasks and the actual skill available; moreover it was possible to measure the influence or the domination over time of one of the two feedback loops: 1) the ability to organize and standardize, and 2) the ability to innovate.

First observations :

- First reduce organizational constraints, rather than insist on re-engineering the organization for innovation.
- Secondly, it is advisable to synchronize the human energy assigned to the progression (innovation) with the energy of conservation or maintenance (organizational routines). Moreover, the search for a better coordination of the levels of infrastructure and superstructure is necessary, failing this, the organization produces its own factors of decline (growth of the organizational costs, resistance to change, etc.)
- Thirdly, the decision-making must be guided by the phenomenon of contiguity in time (like the effect of propagation of the dominos). There is a true systemic intelligence where the rationality of the individual choices rests on a coherence generated by what the system is supposed to make through its interactions.

The following concepts and results have been formulated on the basis of the simulation's preliminary results:

- 1) The organization is a system that combines human, technical, and economic variables. Interactions arising from this combination produce events over time, resulting from decisions that may come from the past (historicity paradigm).
- 2) Changes in the organization's properties impact upon its overall performance, and are also "cost drivers".
- 3) Measuring organizational capacity indicates that over-formalization of the organization may in the long run lead to a slowing of the ability to innovate. Nevertheless, this ability to standardize is essential. By relying on the knowledge acquired from the organizational routines learned by the employees, it actually enables the loss of energy to be minimized, by avoiding having to re-invent professional practices in a different setting. We note the importance of synchronizing these two organizational forces over time.
- 4) The model enables identification of hidden organizational costs. Organizational costs are defined as the sum of the added-value costs + costs of maintenance and consistency + unallocated costs (loss of energy or residual loss)
Added-value costs are the costs of progress and adapting to the environment (training, recruiting better-qualified personnel, organizational learning, quality procedures, a

new innovation process, etc.) intended to improve productivity and efficiency. These expenses are essentially similar to investments.

Maintenance costs are added-value costs that are not directly useful for products and services, such as:

- costs for conserving or maintaining and passing on experience, such as the capitalization of knowledge
- costs of information systems, consisting of charges for capturing, storing, processing, and distributing data
- costs of coordination and of making adjustments between activities and tasks
- costs of checking on activities and results. These partly depend on the confidence level. As confidence falls, control procedures tend to increase, leading to new technical systems for monitoring. In this regard one is reminded of M. Crozier's remarks in an interview published in *'Le Monde'*: "Stop standardizing and normalizing; instead, get people to behave professionally"!

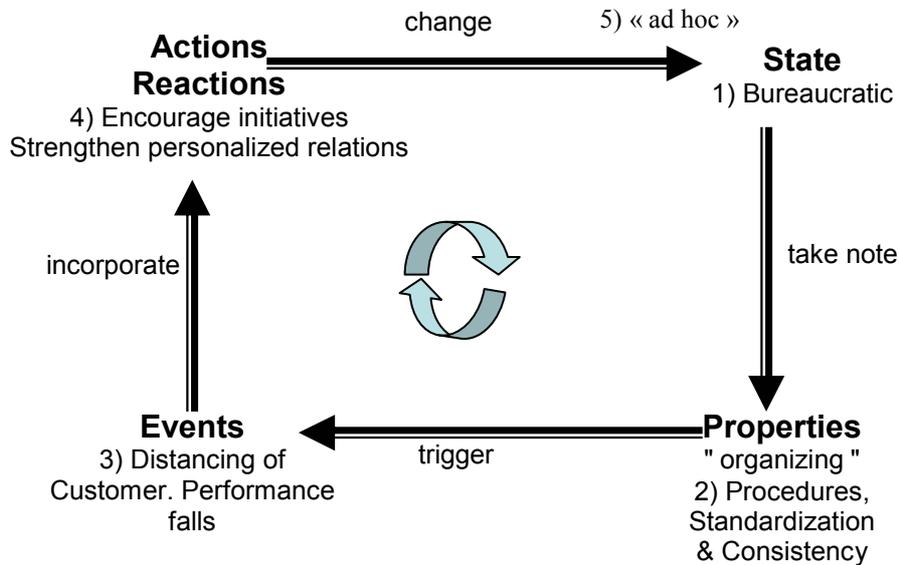
Unallocated costs are costs generated by the discrepancies found between the definition of the organization and the actual results. They generally correspond to wasted expenses that exceed or fall short of the required specifications (under- or over-qualification, information overload, uncertainty in working produced, for example, by vague or undefined instructions causing short circuits in the structure, redundancies, etc.). They have many consequences: a quality problem involving an increase in outstanding debt due to returns, lowered productivity due to personnel rotations that alter the learning curve (rise in unit cost). These are hidden costs that are not recorded in the accounts!

The appendix includes some discrepancies between the target organization and its actual results.

APPENDIX

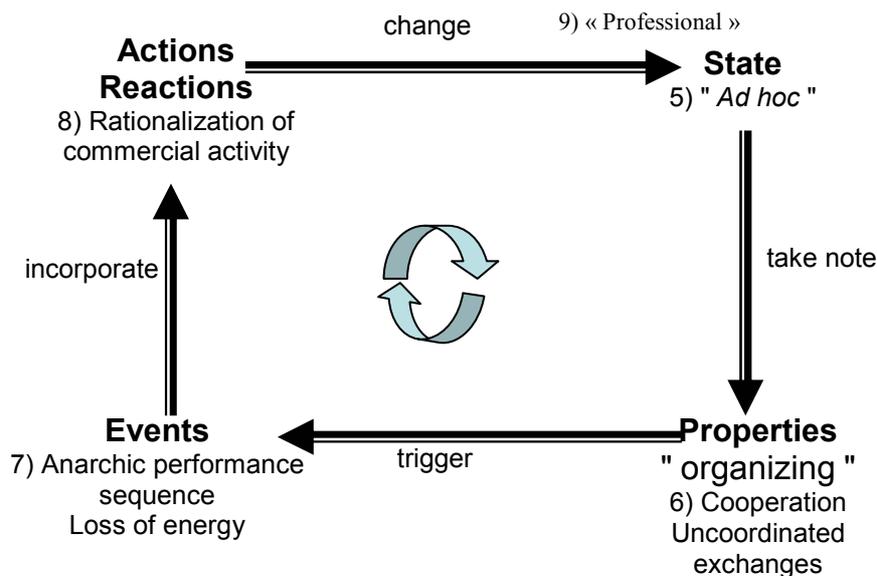
1 Example

- Evolution of bank organization (1) - 1st period: the 1960s and 1970s
Administrative practices: bureaucratic rules dominate

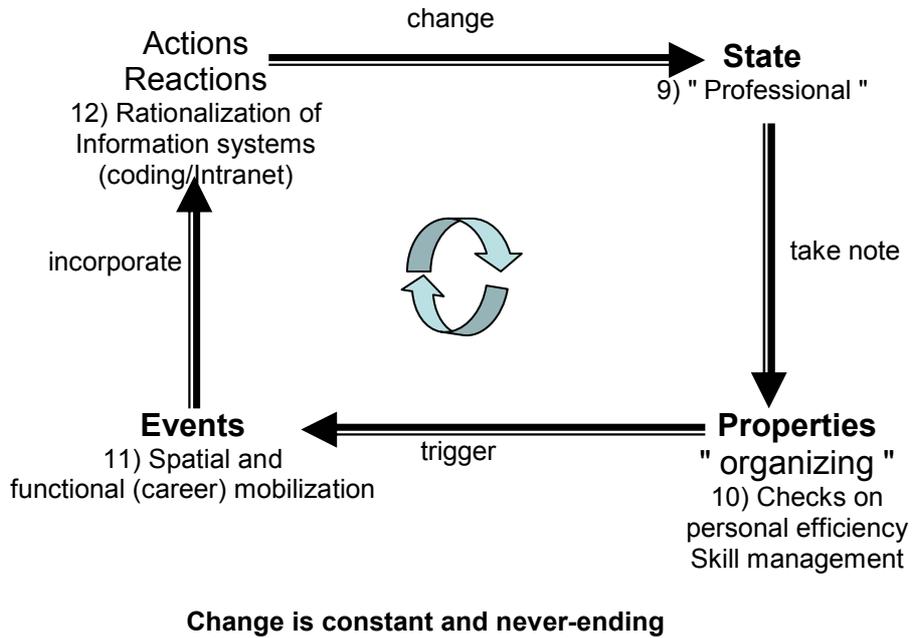


(1): according to Norbert Alter: Ordinary Innovation, PUF, 2003

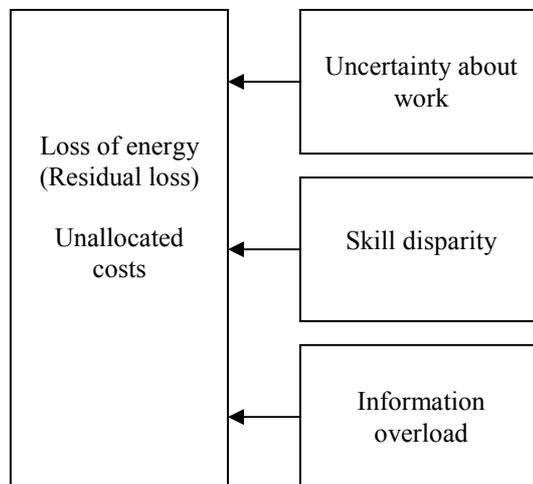
- Evolution of bank organization - 2nd period: the 1980s
Inhomogeneous commercial practices: opening up to markets

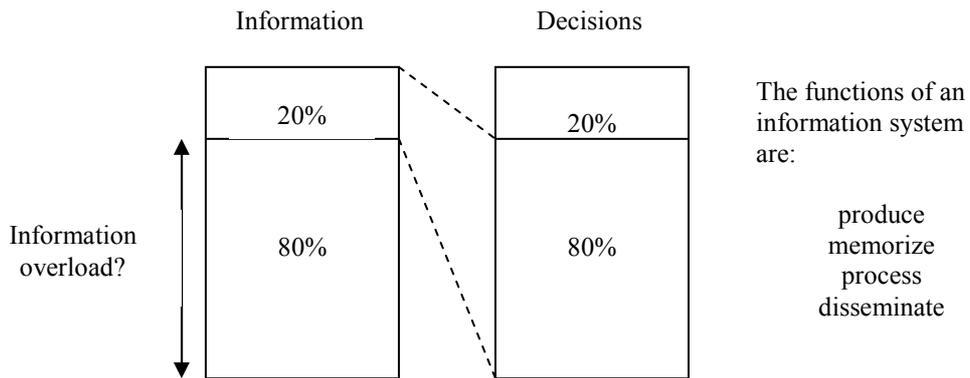
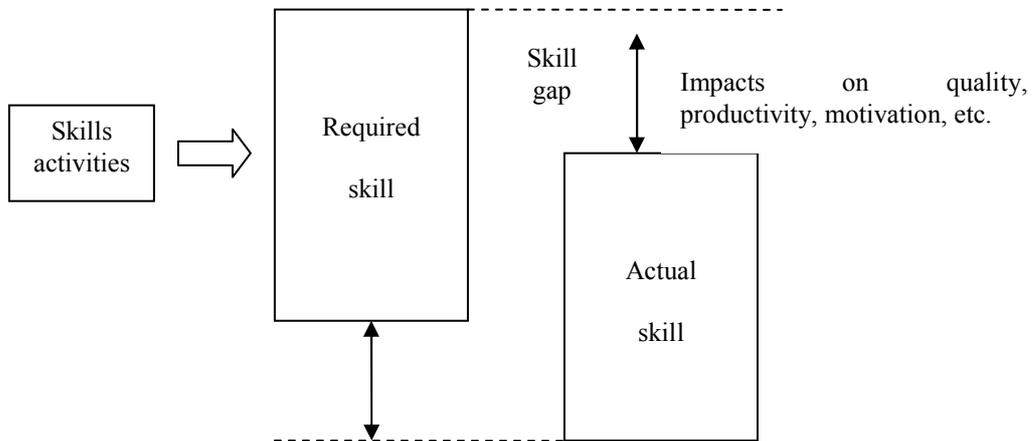
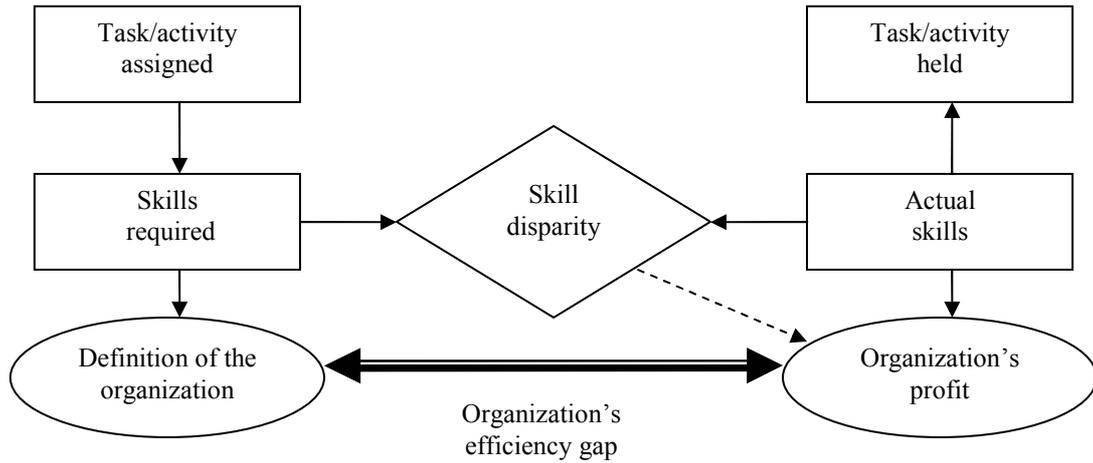


- Evolution of bank organization - 3rd period: the 1990s
Rational commercial practices and activities



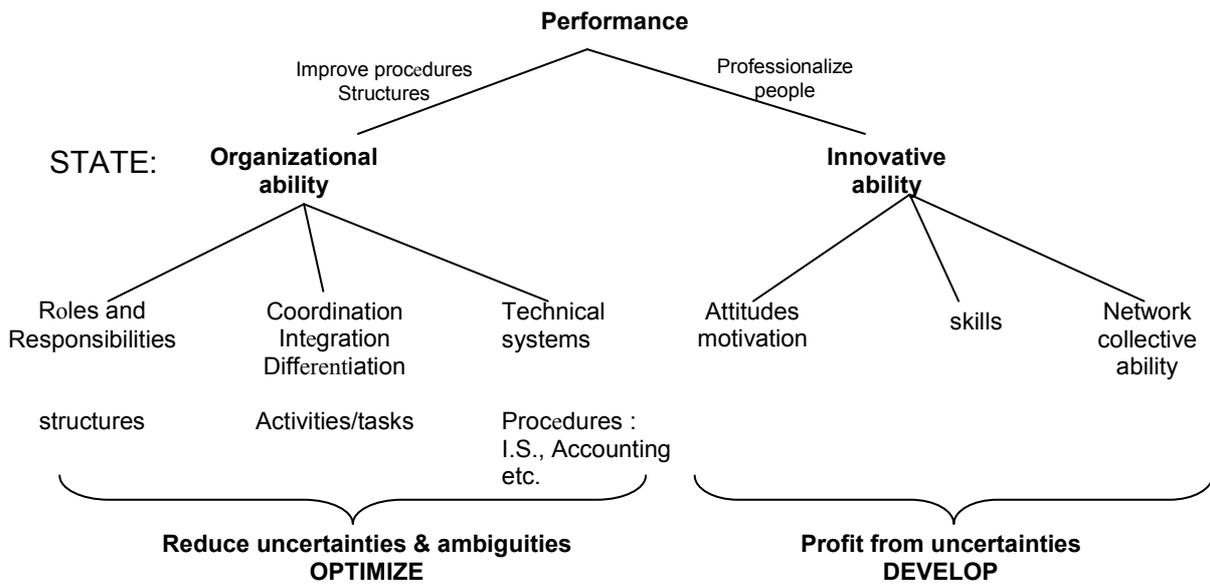
2 Some discrepancies between the target organization and its actual results:



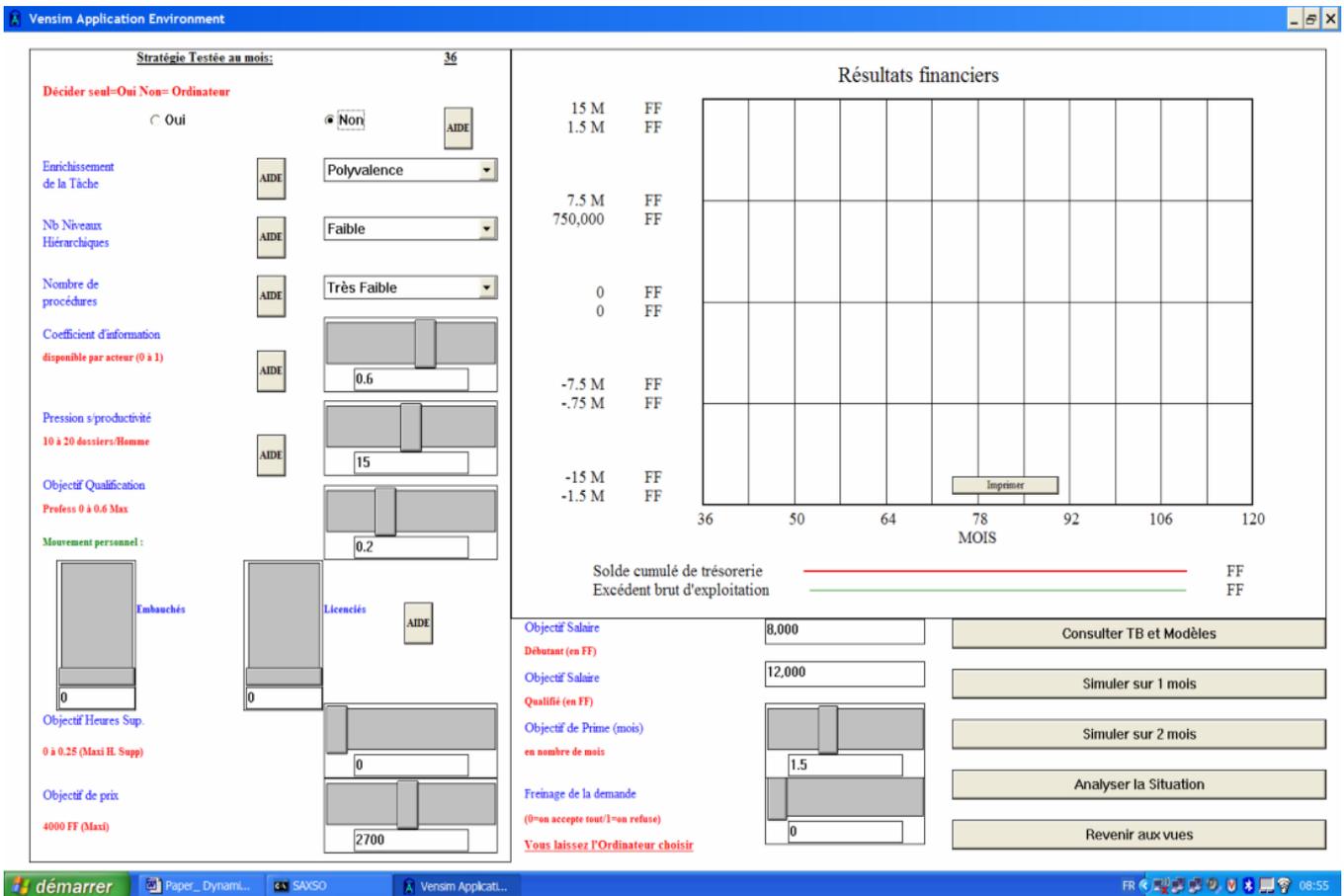


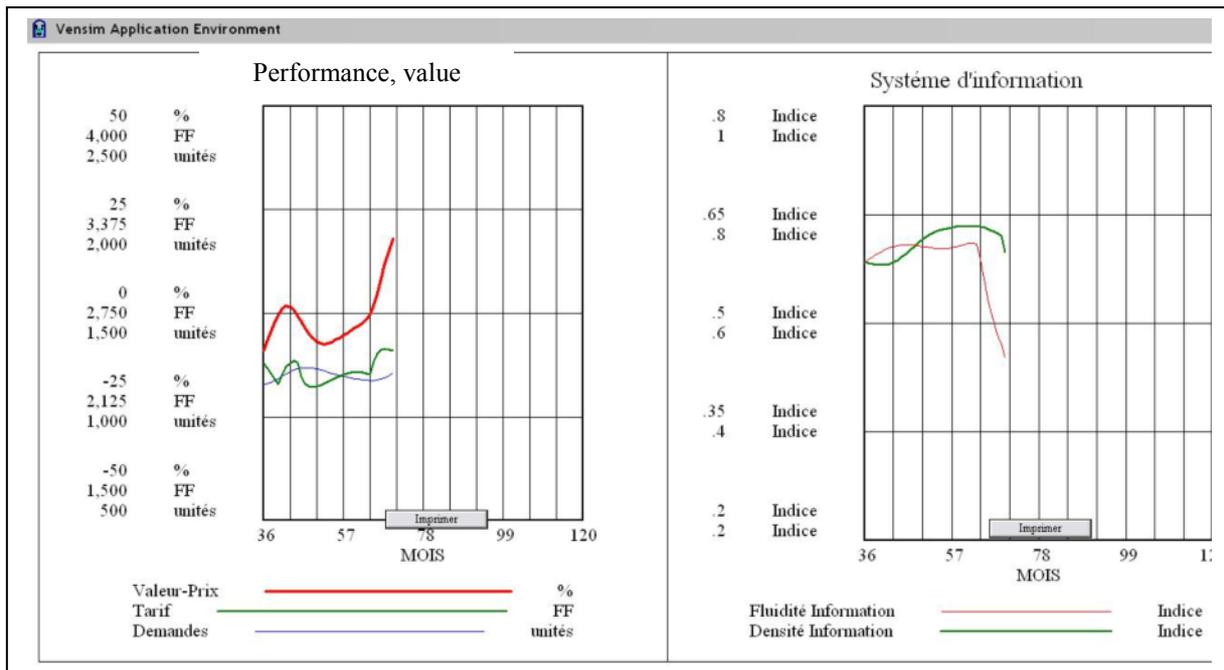
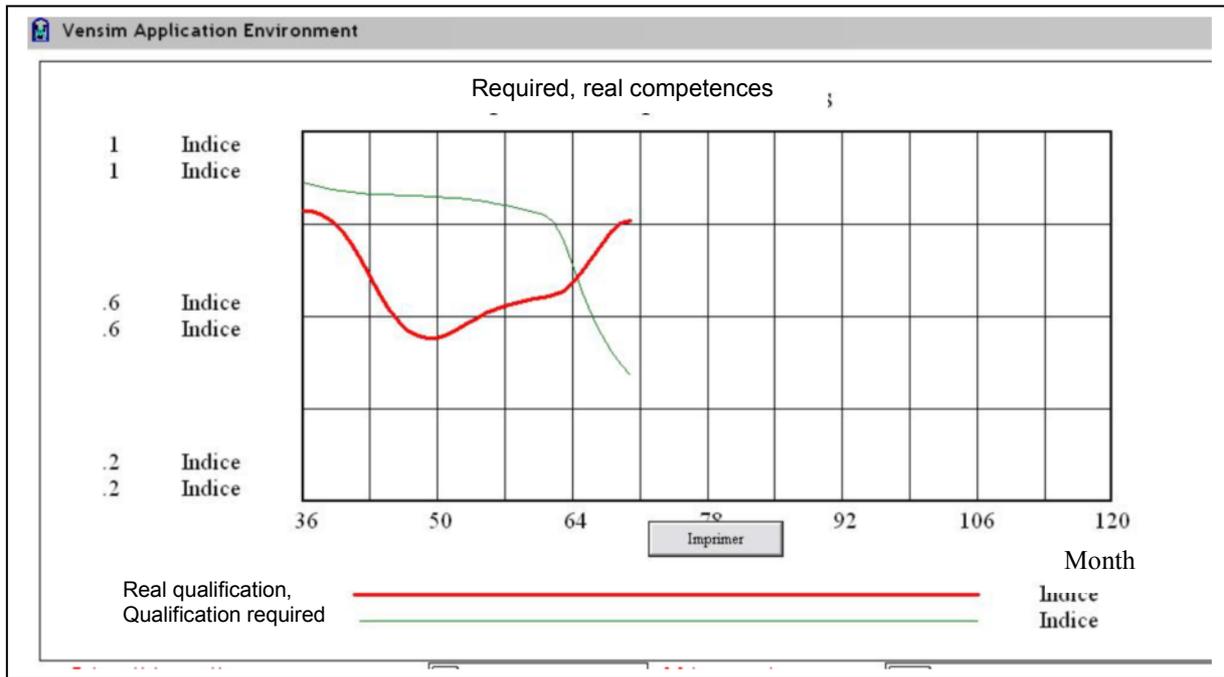
20% of the information enables 80% of the decisions—and the remaining 80%?

3 The model: levers and brakes



4 Some screenshots from the model applied on Vensim software:





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